Concrete

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Stick-It-On-and-Slick-It-Up Houses —and Other Houses

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Editor Concrete

WE need more good houses, not more cheap ones. There is a great deal of the stick-it-on and slick-it-up kind of house building going on in this country. It is very rich in breakfast nooks, mixing faucets, disappearing ironing boards, tinted bas-relief, imitation leaded glass windows, imitation grass cloth, imitation brass hardware, imitation parchment shades. A lot of them are imitation houses.

The foxy, build-it-quick, putty-it-up and paint-it-over builder is capitalizing the great American trait of "falling for" everything that looks like more than it is.

The save-the-surface campaign has gone to everybody's head.

Let's have something under the surface that is worth saving.

* * *

We've been looking at a lot of houses in the last few years—made and in the making. The sell-it-quick-before-it-cracks builders are filling up their houses with catch-penny jimcracks, new-fangled aids to fifteen-minute housework, and few buyers seem to be curious enough to find out what the jimcracks are fastened to. It's like buying an automobile for a silver mercury on the radiator cap.

House buyers have been all befuddled lately. They are so taken with a hundred dollars' worth of attractive accessories that they sink ten thousand dollars in the house that the accessories happened to be fastened to.

There is going to be a reaction to this sort of thing.

* * *

Good stucco is a worthy material—a beautiful covering for a sound structure, with almost limitless architectural possibilities. It is obedient to every whim of line, color, texture. Yet even good stucco is an architectural crime as it is frequently made and applied.

Even good stucco is no better than what is under it. Stucco does not hold up the house. Good stucco stiffens the structure, makes it weather-tight, but stucco *hangs onto* the thing underneath. If the frame shrinks, swells, burns, the stucco cracks, goes to pieces. Stucco is not in any prime essential *structural. It depends on what is underneath.* When it is a bad stucco, as a lot of stucco is—in quality and workmanship of application—it is poor stuff.

And like stucco in that respect are many of the superficial attributes of houses these days. Houses are sold mostly on the basis of the superficialities.

The mixing faucets, the disappearing ironing boards, the saving surfaces—these things are good—good as stucco is good—*but what is there underneath?*

* * *

The builders who prepare themselves from now on to give a satisfactory account of their houses from footings up—as it seems only a few builders are able now to do—should establish a good business and go to bed at night with clean consciences.

Housebuilding seems to be in these days a competition in makeshifts. Building costs more than it did ten years ago; but instead of taking advantage of the far cheaper *relative* cost of good materials and permanent construction; instead of taking advantage of real opportunities for investment, a majority of builders and buyers have their heads turned to cheap makeshifts and shoddy workmanship which are the worst antidotes for higher costs. The buyer is tricked on by the bait of new patent hickydoos ("the very latest thing"); the builder discounts his land contract and hurries up to build more of the same.

We believe that in the very fact that we have been going to extremes in the matter of jimcracks and attractive accessories which are no indication of the real value of the structure, just as at one time we went so strong for the wonders of the gig-saw and ginger-bread scroll work—in this condition is the germ of a reaction. Very soon we are to find out how unimportant are the accessories as compared with the structure which holds them. We are going to demand better houses, houses that are good enough in their structural parts to have the best workmanship put on them—the most convenient accessories, and the finest finishes, with some assurance that these desirable and attractive things, secondary though they are, will "stay put."

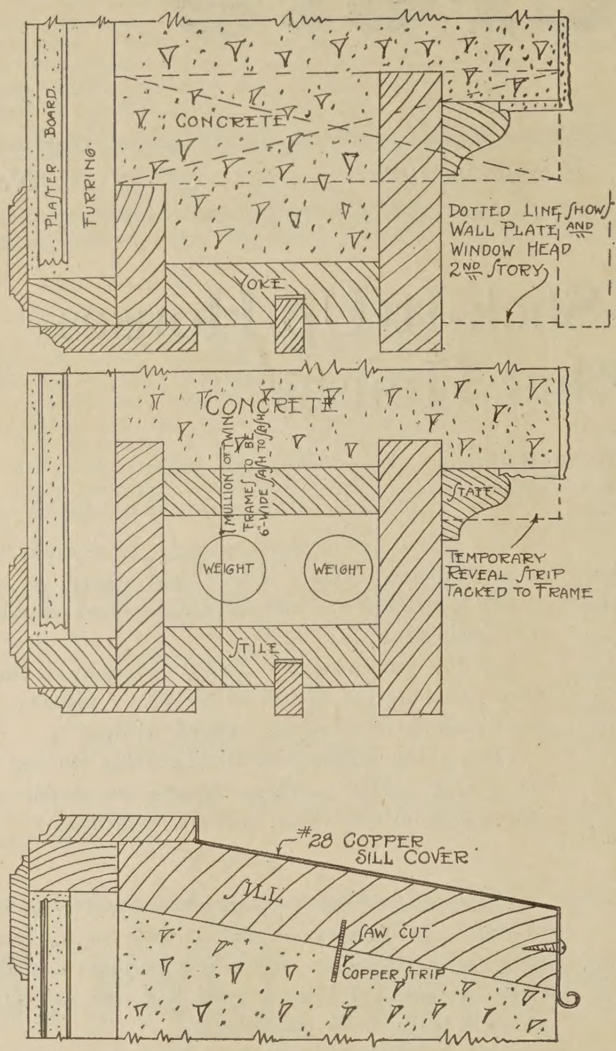

PLASTER BOARD
FURRING
CONCRETE
YOKE
DOTTED LINES SHOWS WALL PLATE AND WINDOW HEAD 2ND STORY
CONCRETE
MULLION OF TWIN FRAMES TO BE 6" WIDE (JAM TO JAM)
WEIGHT
WEIGHT
STAFF
TEMPORARY REVEAL STRIP TACKED TO FRAME
STILE
#28 COPPER SILL COVER
SILL
SAW CUT
COPPER STRIP

Fig. 31—Morrill Details

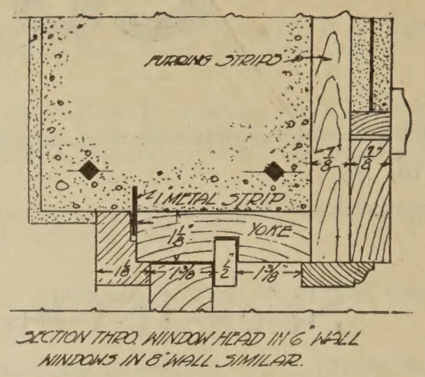

FURRING STRIP
1 METAL STRIP
YOKE
1/8
7/8
7/8
1/8
1 3/8
1/2
1 3/8
SECTION THRO. WINDOW HEAD IN 6" WALL
WINDOWS IN 8" WALL SIMILAR.

Fig. 32—Morrill Details

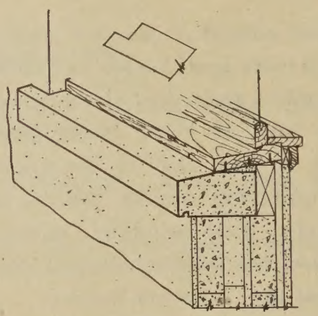
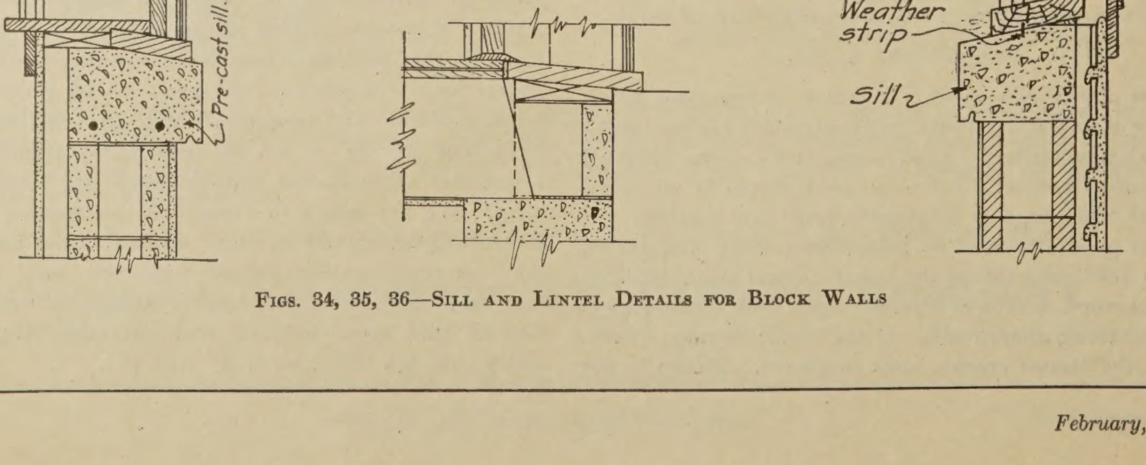


Fig. 33—Slip Sill with Lugs, as Suggested by Portland Cement Association

It's the Structural Details That Count. Here Are Some Sill and Other Window Details as Used for Block and Monolithic Houses.



Figs. 34, 35, 36—Sill and Lintel Details for Block Walls

The Structure of the House

A Review of Concrete House Building Details—Block, Tile and Monolithic, Double and Single Walls

> The "system" used is less important than the man using it—the general features are less important than the details. Here you have a compilation of some ideas that are new and many that have been published before in these pages. Accept nothing blindly. Study carefully those details in which concrete houses differ from other types.

A concrete house, or any other house for that matter, is no better than the weakest part of its structure. It is of no use to have fine finish and decorations unless these are put onto something that will keep them fine. The finish is no better than the walls behind it. By the same token, no matter what pains are taken in the construction of the walls, the walls are no better than the footings; if the footings won't carry the walls it is a poor job from the start. No amount of care in the proper selection of the material for the walls will compensate for bad detailing, or slip-shod workmanship which leaves crevices around the windows and other frames, and openings where water and weather can get through.

Whether a foundation wall is of concrete block or of monolithic concrete, it is probably a good idea to have the construction consistent throughout. If concrete block will make a good foundation, they will make a good upper wall.

Footings

Concrete block are in many places becoming what is almost a standard foundation material. Underneath the walls should be a footing to distribute the load properly. How the load should be distributed depends upon the character of the soil. Some soils are so soft that they cannot safely be loaded with more than one ton to the square foot. Hard gravel and well compacted clay will carry about eight tons to the square foot and some rock can be loaded up to one hundred tons per square foot. A concrete footing should be wide enough and strong enough to carry the load of the walls to the ground and so distribute it as not to over-test the bearing power of the soil. For the ordinary residence, a footing 18 in. wide and 12 in. thick will usually be found sufficient. The extra weight and spread of the footing over what is common practice in many places is a good investment. We have seen houses erected on nothing more substantial than one layer of brick, flat side down, and buttered over on top with a very little mortar, the wall being laid directly on top of such a layer of brick.

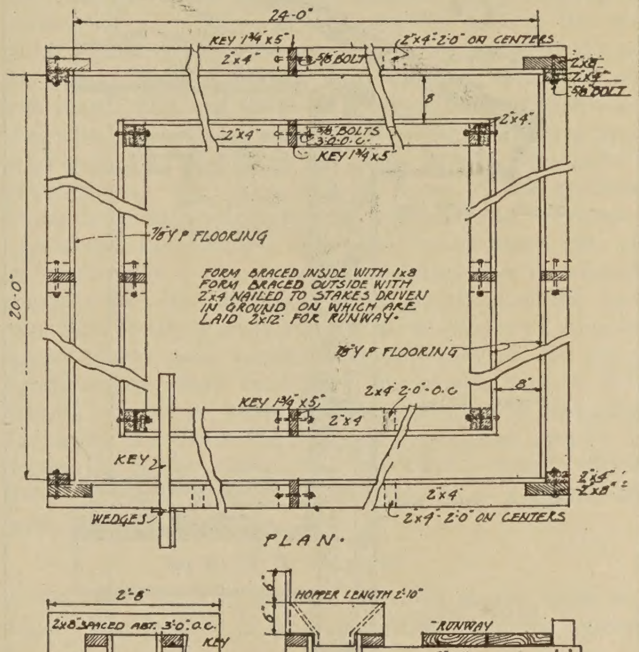


Fig. 1—Wood Forms of This Type, Built in Panels, Were Used Successfully on About 25 Successive House Jobs at Phillipsburg, N. J., for Foundation Construction

Walls

The thickness of walls and the way they are built in some other respects will be governed in some cases by local regulations. It is common in some cities to require 12 in. block for foundation walls; such weight is entirely unnecessary for the usual small dwelling, if the block are of good quality. A 10-in. block should be ample. Eight-in. block for foundation walls require extra care in laying up. In Chicago and in some other cities, building regulations require that hollow block shall be filled with slush concrete, in such a way as to make practically a monolithic wall. This is not by any means necessary if the block are properly laid up. Filling the cores of the block with slush concrete defeats the special advantage of the hollow block, which gives a cellular structure in the wall, providing valuable insulation. It is necessary to use care in laying block to get a sound and water-proof wall. It should be with good cement mortar, block should be well bedded and both ends of the block should be buttered and rammed snugly together. The time to make a basement wall water-tight is when it is built. It costs less for the extra workmanship and a little extra material to make a good job at the start than to fix it up afterwards. If properly made, a concrete basement wall is water-tight.

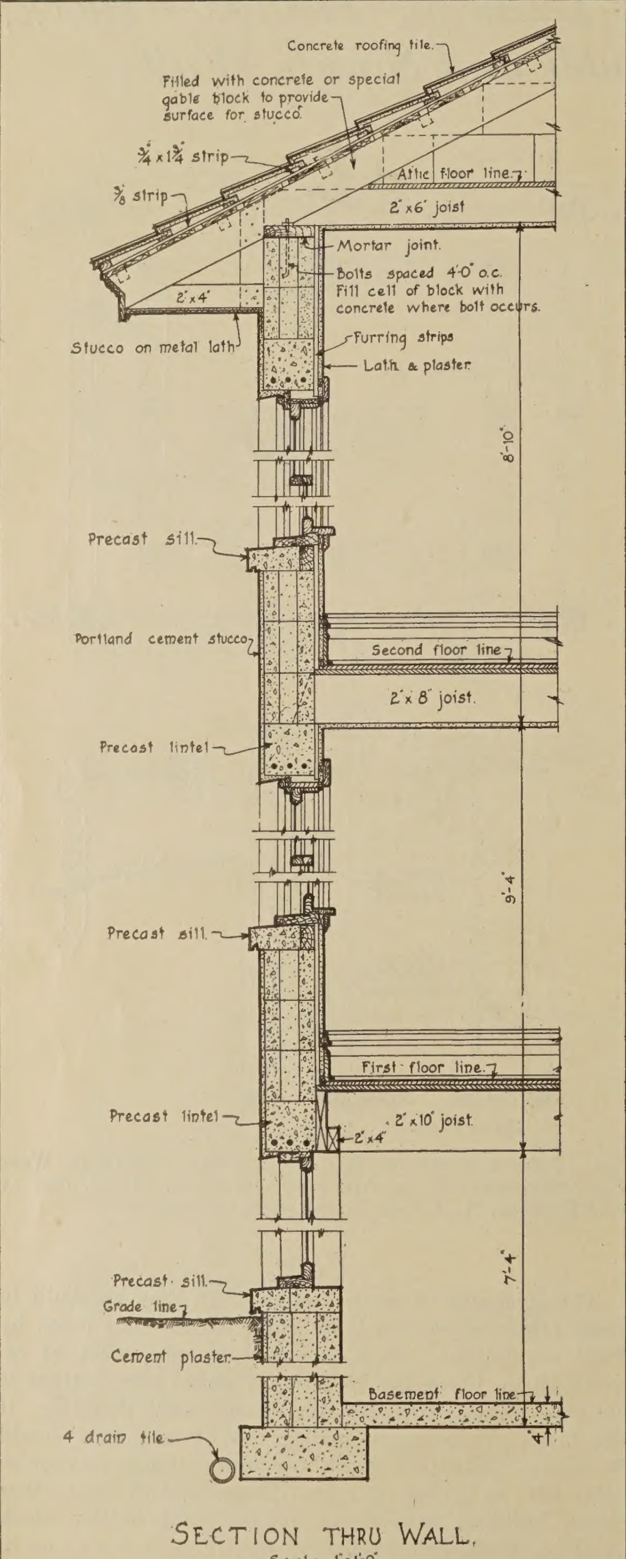


Fig. 2—Details Recommended for Concrete Block House Construction by the Portland Cement Association in Connection with Sale of House Plans

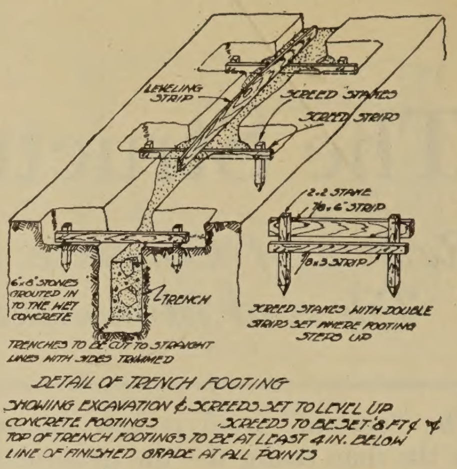

LEVELING STRIP
SCREED STAKES
SCREED STRIP
2×2 STAKE
⅞×6" STRIP
⅞×3 STRIP
6"×8" STONES GROUTED IN TO THE WET CONCRETE
TRENCH
SCREED STAKES WITH DOUBLE STRIPS SET WHERE FOOTING STEPS UP
TRENCHES TO BE CUT TO STRAIGHT LINES WITH SIDES TRIMMED
DETAIL OF TRENCH FOOTING
SHOWING EXCAVATION & SCREEDS SET TO LEVEL UP CONCRETE FOOTINGS
SCREEDS TO BE SET 8 FT ¢ ¢
TOP OF TRENCH FOOTINGS TO BE AT LEAST 4 IN. BELOW LINE OF FINISHED GRADE AT ALL POINTS

Fig. 3—Method of Constructing Trench Footings as Used in Connection with Morrill System of Steel Forms

Drainage

A line of drain tile should be placed entirely around the outside of the footing. It should be covered over with a few inches of loose material. This drain should lead somewhere to a suitable outlet. The drain tile in itself does not *take the water away* from the house. The object of the loose material and the drain tile is not to provide a pocket for the water to go into but a channel to lead it away. Sometimes the drain tile is placed inside the footing. It is better to have it outside, but it is sometimes desirable to have it in both places. When the wall is finished it should preferably be covered with at least two coats of cement plaster, applied on the exterior surface. It is a desirable finish for either a monolithic wall or a block wall—as soon as the forms are removed in the case of a monolithic wall, or as soon as the mortar joints are hard in the block wall. Under

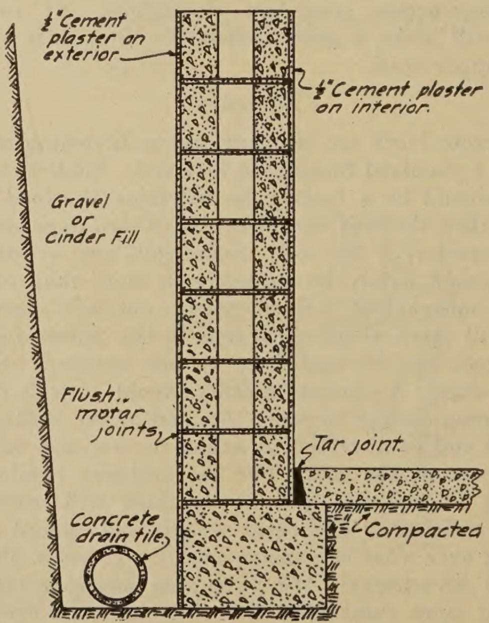


Fig. 4—Concrete Block Basement Walls So Constructed with Average Workmanship Will Be Water Tight

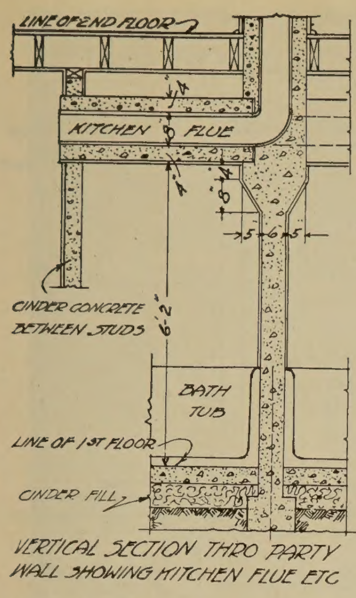

LINE OF 2ND FLOOR
KITCHEN FLUE
CINDER CONCRETE BETWEEN STUDS
BATH TUB
LINE OF 1ST FLOOR
CINDER FILL
VERTICAL SECTION THRO PARTY WALL SHOWING KITCHEN FLUE ETC

Fig. 5—The Morrill System Group Houses at Claymont, Del., Have Kitchen Flues Just Below the Second Floor, Carried Across the Bathroom as a Hollow Reinforced Concrete Beam — These Flues Have Terra Cotta Linings

special conditions where extra precautions are necessary, this plaster surface should be coated with some one of the asphaltic preparations which are painted on with a stiff fibre brush.

With proper footings there is no reason why a monolithic wall should be more than 8 in. thick for a small dwelling, with upper walls 6 in. thick. Some building regulations, however, insist upon a greater thickness.

A house is much more rigid, much more free from undesirable settlement, if the interior bearings are upon solid partitions rather than small iron posts. Basement partitions may be of 4-inch concrete block or tile and for walls of this section, the precast unit in some form is undoubtedly preferable to monolithic concrete. An additional advantage of such masonry partitions over the usual thin wooden partitions, which are commonly used when interior posts are employed, is in shutting off the parts of the basement and preventing the spread of possible fire. It is particularly desirable that the heating apparatus be so walled off, not only for safety from fire but as a means of keeping the rest of the basement secure against dust and dirt of the heating equipment.

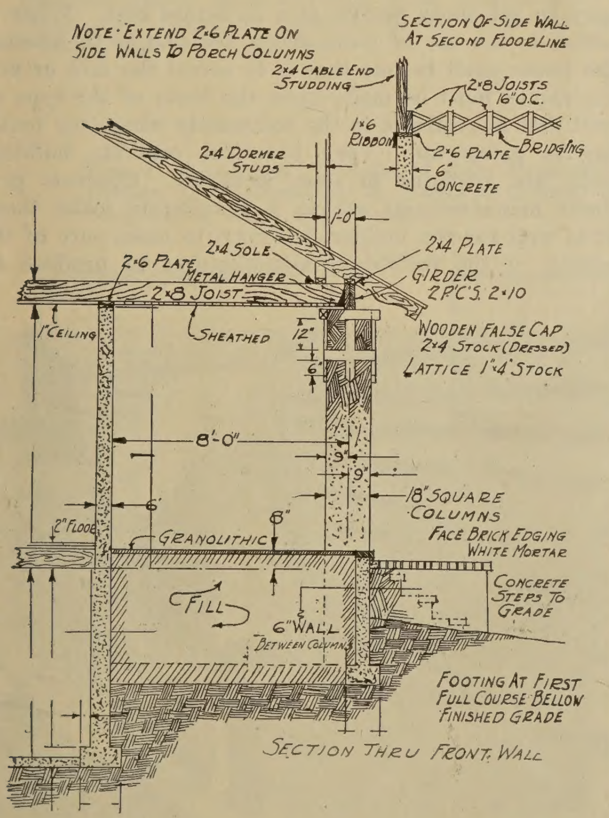


Fig. 6—Details of L. C. Thompson Houses (Morrill System, Monolithic Construction), Near New Haven, Conn.

When it comes to the walls of a house above grade, there is less choice than one might imagine, among a number of very different systems, for getting the results. This magazine in years gone by, particularly in its annual House Building Numbers, has described no less than a hundred different systems of wall construction with concrete. A considerable number of these systems give good results in the hands of men who understand them. The draw-back to some of the systems which have been advocated for concrete wall construction is that they involve details not easily taken care of in breaking in a new crew. Experience has developed the fact that the originator of the system and the men who have worked with him in its development usually secure pretty good results with that system. In other hands, under other conditions, the results may be different. Concrete house building involves a necessity for study of certain fundamental details, not merely in design but in the construction operations—details which differ in concrete house construction from construction with other materials.

The Builder

We are in need of builders who will master these details. The builder is more important than the system he uses.

The thing for the prospective house-owner to do is to find a builder familiar with *some* system of building

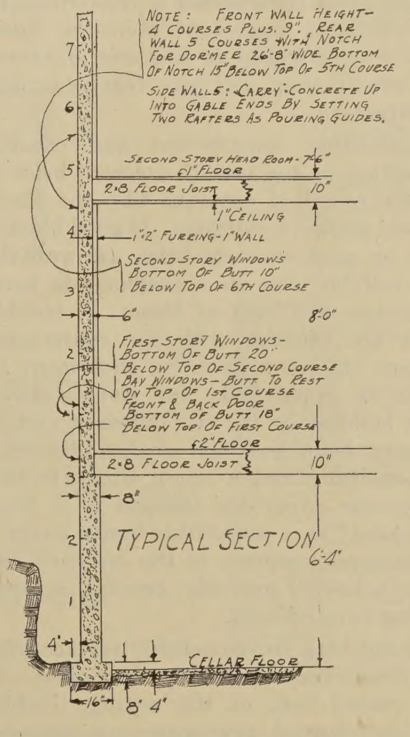

NOTE: FRONT WALL HEIGHT- 4 COURSES PLUS. 9". REAR WALL 5 COURSES WITH NOTCH FOR DORMER 26'-8" WIDE. BOTTOM OF NOTCH 15" BELOW TOP OF 5TH COURSE
SIDE WALLS: CARRY CONCRETE UP INTO GABLE ENDS BY SETTING TWO RAFTERS AS POURING GUIDES.
7
6
5
SECOND STORY HEAD ROOM - 7'-6"
1" FLOOR
2·8 FLOOR JOIST
10"
1" CEILING
4
1"·2" FURRING - 1" WALL
SECOND STORY WINDOWS BOTTOM OF BUTT 10" BELOW TOP OF 6TH COURSE
3
6"
8'-0"
FIRST STORY WINDOWS - BOTTOM OF BUTT 20" BELOW TOP OF SECOND COURSE
BAY WINDOWS - BUTT TO REST ON TOP OF 1ST COURSE
FRONT & BACK DOOR BOTTOM OF BUTT 18" BELOW TOP OF FIRST COURSE
2
1
2" FLOOR
2·8 FLOOR JOIST
10"
3
8"
2
TYPICAL SECTION
6'-4"
1
4"
CELLAR FLOOR
16"
8' 4"

Fig. 7—Such a Drawing on the Job Helps Eliminate Errors — Used by L. C. Thompson, New Haven, Conn.

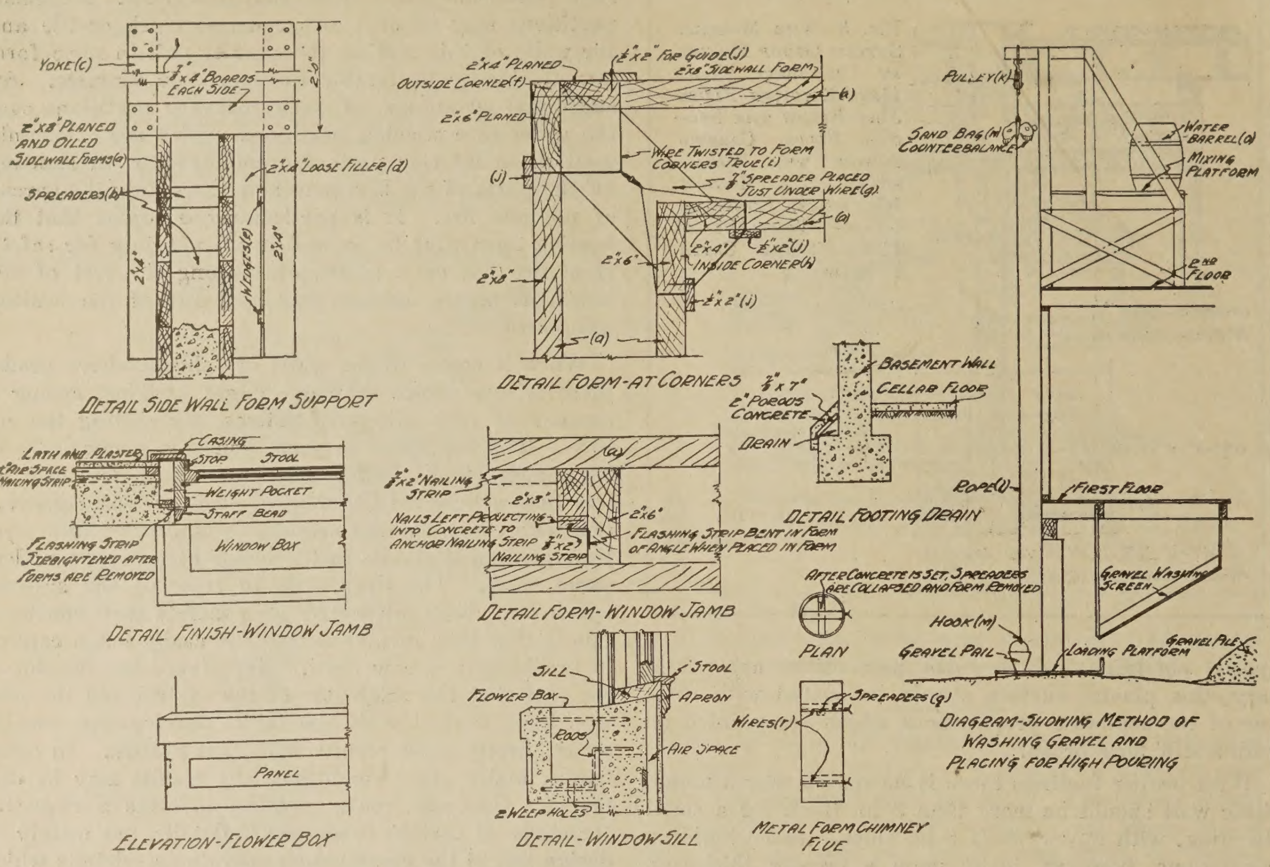


Fig. 8—Kinks and Details Used in Monolithic House Construction at Stoneham, Mass., by A. P. Rounds

with concrete. The thing for the builder to do is to study various systems which are available for his use and select that system which seems to be best adapted to his particular requirements, taking into consideration the extent of his operations, the variety of the work he expects to execute, and the amount of work he anticipates having to undertake at one time.

So far as the individual home-owner is concerned, the personal equation is more important than the equipment; and a builder experienced in any one of several systems of house construction will give results in most cases entirely satisfactory.

As between monolithic construction and concrete block wall construction or the use of concrete brick or some of the lighter so-called concrete tile, the choice is largely one of local market conditions. If good block or good building tile or good concrete brick are available and builders are available who are accustomed to handling them, good houses are built of them. If builders are available who are familiar with the construction of monolithic houses and they have the equipment for the work, there is an opportunity for study between what two different builders by the two different systems can do. There may be a personal choice between a house which is monolithic and a house which is built of units. Some people enjoy the thought of a house that is all in one piece, as a monolithic house ought to be; yet for all structural purposes of the ordinary resident, the unit built house, properly erected, is quite equal to all dwelling requirements.

The methods of finishing the monolithic surface other than with stucco are perhaps not fully developed—not at least for the pocket-book of the average builder. Beautiful results in exposed aggregates are possible, but few builders are familiar with the methods necessary to get those results at a moderate cost. When it comes to the use of units and a decision as to whether the house shall be one that is to reveal the unit or not, the choice must be made upon the basis of the type of unit that is available in the community where the building is going up. Very beautiful concrete building units are available in some localities. Concrete products manufacturers are in a position to make them. It is well for the builder, however, to make sure of the ability of the individual manufacturer to produce an

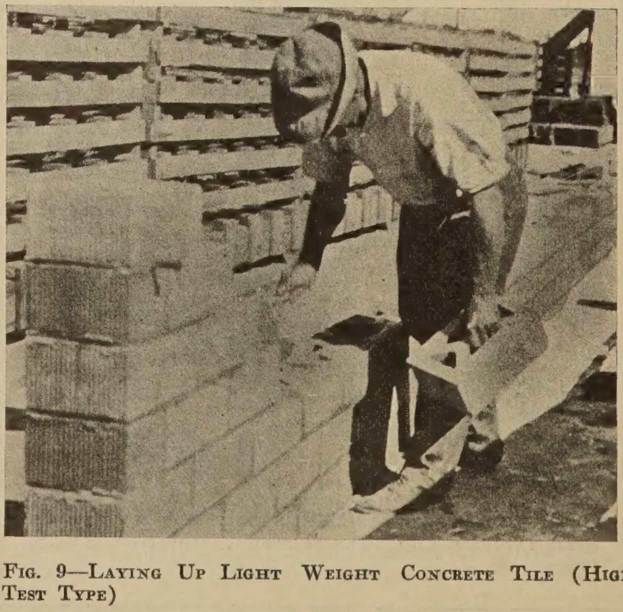


Fig. 9—Laying Up Light Weight Concrete Tile (High Test Type)

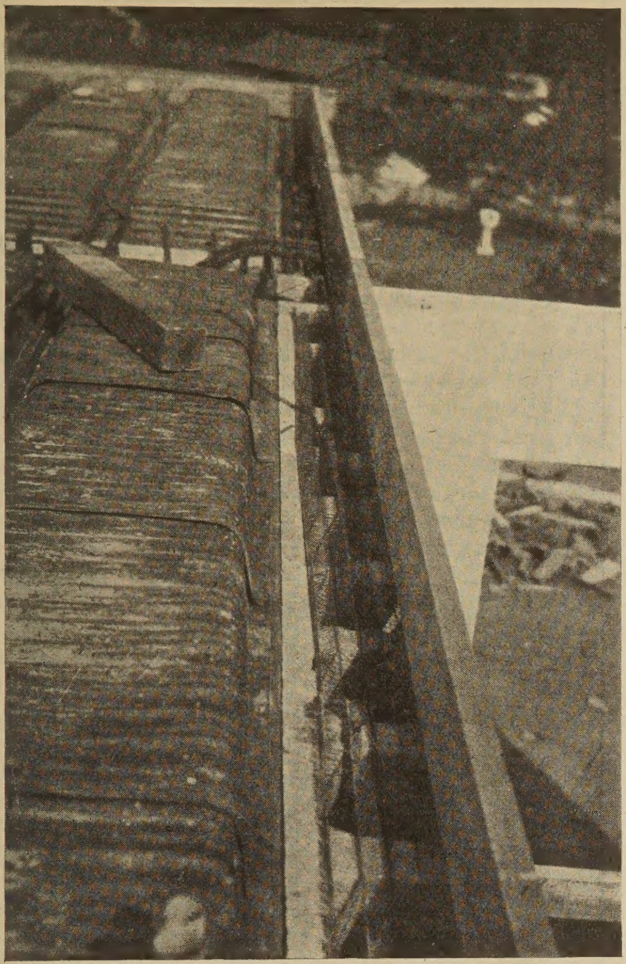


FIG. 10—(ABOVE) BEAM AND SLAB FLOOR CONSTRUCTION, WITH METAL PAN FORMS, ON CONCRETE BLOCK HOUSE JOB—METAL FABRIC COVERS BLOCK OPENINGS

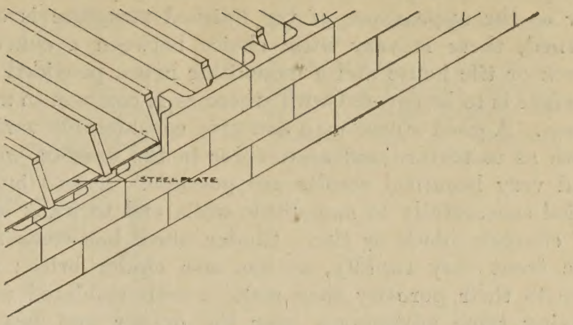


FIG. 13—HOW FLOOR JOISTS ARE SUPPORTED BY ⅜-IN. STEEL PLATES WHEN SINGLE WALL HYDRO-STONE BLOCK ARE USED

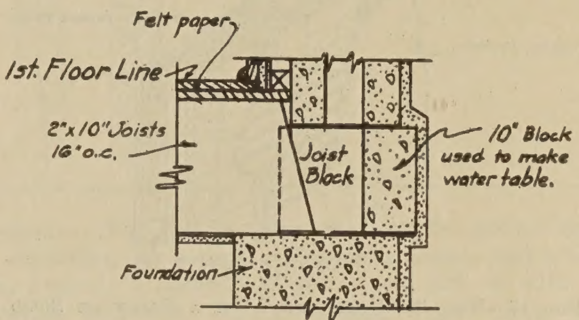
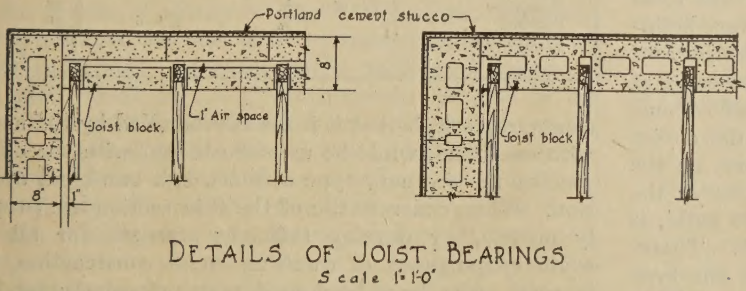


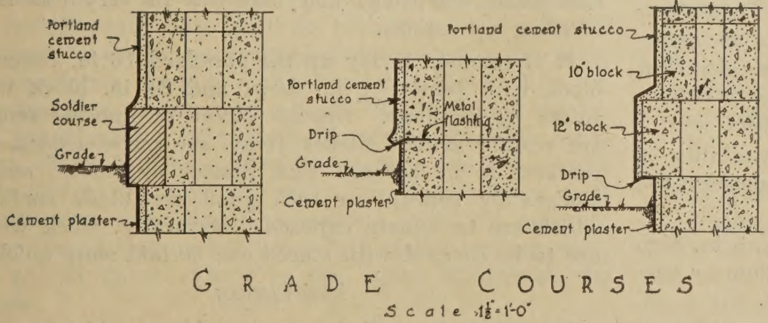
FIG. 14—TEN IN. JOIST BLOCK ON 12 IN. WALL

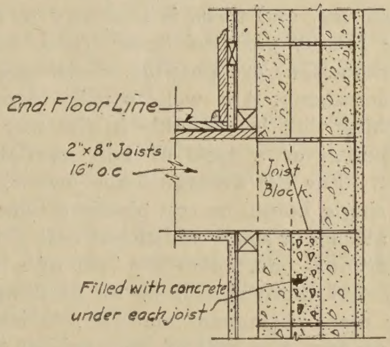
FIG. 15—(SEE BELOW)—HOW JOISTS ARE TO BE SUPPORTED ON BLOCK WALLS WHEN FLOOR LOADS EXCEED 60 LBS. PER SQUARE FOOT

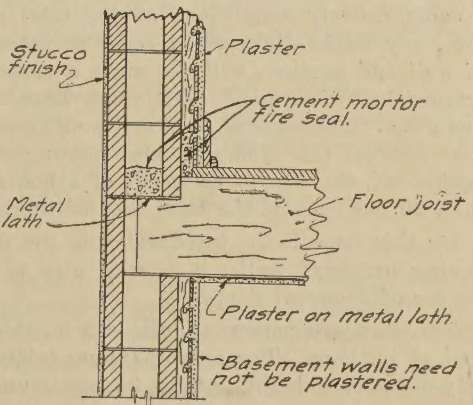
FIG. 16—(LOWER RIGHT) JOIST SUPPORT WITH FIRE SEAL FOR FLOOR LOADS OF 60 LBS. OR LESS PER SQUARE FOOT

FIGS. 11-12—(BELOW) DETAILS OF JOIST BEARINGS AND GRADE COURSES, AS RECOMMENDED BY PORTLAND CEMENT ASSOCIATION, WITH BLOCK WALL CONSTRUCTION









acceptable block, brick or tile for facing purposes. So far as the appearance of the finished structure is concerned, there is very little choice between a concrete block or tile house and a monolithic house provided the surface is to be covered with stucco as is common in most cases. A good stucco man can give considerable variety both as to texture and as to color in the finished work, and very beautiful results are possible. Stucco is applied successfully to monolithic walls and to walls built of concrete block or tile. Cinder block has come into the front very rapidly, as has also cinder brick; and due to their porosity they make a well insulated wall, having some advantages over the denser and heavier gravel or stone concrete block made by ordinary methods. Such cinder units, however, should be covered with a good coat of waterproof stucco, and finished as in any other type of wall that is to have that treatment.

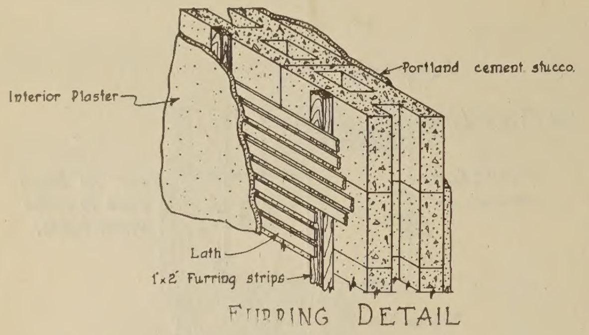


Fig. 17—How To Furr and Lath a Block or Solid Monolithic Wall

Cost

As to cost—If an investor is building a considerable number of very low priced houses, where he has opportunity for standardization of certain details, interior and exterior, and there is necessity to reduce the price to the lowest possible figure (and very considerable price reductions are possible where quantity work is to be undertaken), it is well to make a careful survey of everything that is available in the way of a system of construction or a type of unit available in the local market. For the average home owner, however, building a single house, he can obtain a house with fireproof walls at such a small additional cost (in some cases at no additional cost) over the cost of a well-built frame house, that there should be no hesitancy in the choice of the more permanent material. Furthermore, on the basis of cost, the cost of the shell of the house in the type of home which the average man wants to build, is a comparatively small part of the total cost. Therefore, any slight difference in cost as between one type of wall and another, will not make a very material difference in the ultimate cost of the house. Depending upon the elaborateness of finish and various architectural details, the plumbing and heating and electrical equipment, the cost of the shell of a house may be less than 20 per cent of the total cost of the house.

On this same basis, in considering the desirability of having fireproof walls, it is well also to consider the matter of fireproof floors.

The standard concrete block is 8 in. thick, 8 in. high and 16 in. long. The accompanying table shows a variety of concrete building units in common use.

One thing very much in favor of the light weight so-called concrete tile which has a thinner web than the concrete block, is that it is usually handled by the mason with one hand, while he uses the trowel with the other; placing the ordinary type of block is a two-hand operation. When concrete tile of the thin section are properly made, they develop sufficient strength for all the ordinary purposes of dwelling house construction, and in some cities have been used very extensively for curtain walls, partitions and back-ups in very extensive building operations.

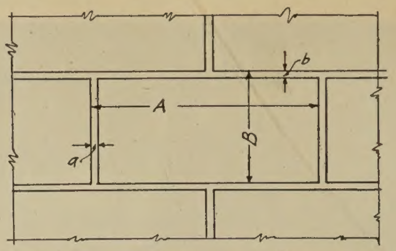


Fig. 18—The Lettered Dimensions Correspond Directly to the Dimensions Given in Table

Dimensions of Concrete Block
(See Figure 18)

(Double Rectangular Air Space Type)	Total Length of Block, inc. Perpendicular Joint	Thickness of Perpendicular and Horizontal Joints	Total Height of Block, including Horizontal Joint	Block Thickness
Block System	A	a	B	C
Eclipse	16 inches	¼ inch	8 inches	8, 10, 12 in.
Francis	16, 24	¼	8	8, 10, 12
Hayden	16, 20, 24	¼	8	8, 10, 12
Ideal	16, 24	¼	8	8, 10, 12
Multiplex	20	⅜	6, 8	8, 10, 12
Perfect	16	¼	8	8
Pettyjohn	16, 20, 24	¼	8	8
Republic	16	¼	8	8, 10, 12
Stewart	16	¼	8	8, 10
Waterloo-Perfection				
Zagelmeyer	16, 24	⅝	8	8, 10, 12
(Single Rectangular Air Spaces)				
Dunn	16	¼	8	8, 10, 12
Hercules	16, 20, 24	¼	8	8, 10, 12
Miles	16	¼	8	8
(Elliptical Air Spaces)				
Besser	16	¼	8	8, 10, 12
Brandell	16	¼	8	8, 10, 12
Hobbs	16, 20, 24	¼	6 to 12	8, 10, 12
U. S. Standard				
(Double Wall Types)				
Anchor	16	5/16	8	8
Bragstad	24 inches	¼ inch	8 inches	10 inches
Climax				
Flexo				
Helm	24	¾	8	10
Hydraulic Ramming	24	H-¼ V-⅜	9	12
Hydrostone	24	⅜	9, 12	8, 12, 16
Viani	30		6, 8	12
(Building Tile)				
Besser	12	¼	5	8, 12
Blystone	12	¼	5	8, 12
Eberling	12	¼	5	8, 12, 16
Erickson	16	¼	6	8
Hy-Test	8, 10, 12	¼	5	8
McIntyre	8, 10, 12	¼	5	8, 12
Picabbs (Adistile)	20	¼	4, 5, 6	7, 10

It is common to lay up the standard 16 in. concrete block with joints ¼ in. deep, and 24 in. block with joints ⅜ in. deep. Special pieces of unusual length are readily made. Struck joints are recommended for surfaces to be covered with plaster or stucco, and a moderately concave or tuck joint for block surfaces which are to remain exposed. Naturally, block which are to be covered with stucco can be laid more quickly.

Insulation

Except for so-called two-piece block, which provide a continuous air space up and down throughout the wall, with no solid connecting web extending from one side to the other, all concrete block walls in the more northerly latitudes should be furred before plastering on the inside. This is entirely as a precaution against heat losses. Concrete walls like other types of masonry are good heat conductors, when built solid. When it is cold outside the house and warm inside the house the tendency through a wall of this type is constantly toward equalization of temperature; thus to sit with one's back against a solid concrete wall when it is cold outdoors is to feel a decided sensation of chill. The fact that a wall of this kind sometimes shows moist spots on the inside is not to be attributed in any way to the penetration of moisture from the outside. A cold wall condenses moisture out of the warm interior air, just as a window pane does or an ice water pitcher. The beads of moisture on the outside of the pitcher do not come from the inside, they come from the air outside, due to the condensation brought about by contact of the warm interior air of the room with the cold surface of the pitcher. The presence of such moisture spots on a wall is merely an indication that the wall is not properly insulated. If the wall were absolutely water-proof, the condition would still exist. This condition, however, has brought about criticisms, in some cases, of concrete houses, critics wrongly assuming that a concrete house is damp. A solid brick wall, a solid stone wall, a solid masonry wall of any of the ordinary types, would give the same results. One must observe the fundamental necessity for insulation with concrete walls as with the others. No one thinks in a northern climate of building a solid brick wall without furring it on the inside, leaving an air space for insulation. It was thought by some builders that the hollow spaces in the ordinary type of block would provide sufficient insulation. They do not provide enough insulation because they do not provide a complete air space on the entire wall area. Probably the best insulation possible in a solid concrete wall is obtained in a wall made of cinder concrete, with no sand, or comparatively little sand, in the mixture. It is a porous wall and its network of air cells provides effective insulation. Such a wall may be less nearly water-proof than a dense wall, but it is a better insulated wall. In order to make the cinder concrete wall water-proof, a good coat of water-proof stucco on the outside is usually all that is necessary. Unfurred walls, however, are not to be recommended with any of these materials. An exception is made in the case of two piece block as already mentioned, and also in the case of monolithic walls which are made in two parts, by the so-called double wall system, where two connecting 4-in. webs, each of them usually 4 in. thick, are connected by, for rigidity, small metal ties. The floors in such construction bear entirely upon the inner web. Such continuous air space should be closed tight at top and bottom to prevent the circulation of air. Circulation of air is always opposed to good heat insulation. If it were practicable to fill the hollow space in a double concrete wall with some light cellular material, like cork, the insulation would be better than that provided by the continuous air space, the cellular structure thus obtained providing the best insulation, because of the tendency of air to develop currents as it is warmed on one side and cooled upon the other. In double block wall construction as in double monolithic walls, the concrete floor should rest on the inner half of the bearing wall. It should never extend to the outer surface of the block.

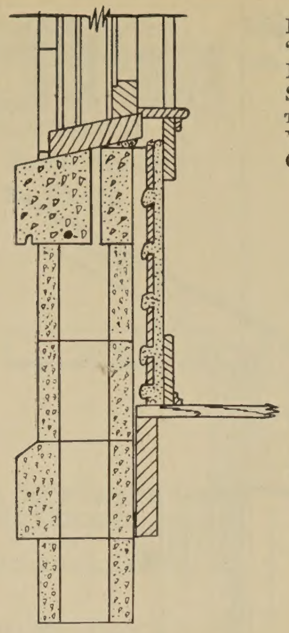


FIG. 19—THE USE OF THE "SPLIT" OR TWO-PIECE SILL IS HERE SHOWN—THE SPLIT SILL IS A POSITIVE PROTECTION AGAINST INGRESS OF WATER, AND IT REDUCES CONDUCTIVITY OF HEAT

Insulation as a definite problem in house building is coming to be a matter of more generally recognized importance. The fuel problem which in the pioneer days of exploiting our natural resources in forests and mines, was scarcely a problem at all, is now with us with increasing emphasis. If by building better houses the individual fuel buyer can save two or three tons of coal a year, it mounts up into large figures of household economy and larger figures of national conservation.

Hueber Bros., in Syracuse, are lining their new concrete houses with Armstrong cork board 1 in. thick, nailed in sheets to the cinder concrete monolithic walls, and using it as a plaster base. There is a popular knowledge of cork as an insulator which makes the use of such material a big selling argument. The prospective buyer opens his eyes at the idea of a cork-lined house and the cost of such a lining is not a serious matter. It saves lath, furring and labor and economizes finish plaster. So that the extra cost is very small compared to the results obtained.

Kate Gleason is using Linabestos rather than stucco for half timber gables. She finds it an advantage in cold weather construction and a good insulator, and cheaper than stucco on metal lath.

On a house built at Euclid Beach park, Cleveland, J. E. Lambie lined his solid concrete walls with Celotex, a new sheeting product made from sugar cane fibre and having high insulating value.

Balsam Wool, with a high rating as an insulator, is on the market in rolls quilted, so to speak, between water-proofed paper. It is also said to be treated to make it, in a measure, fire resistant. The wool is also used for calking.

Porete is a cement product with a cellular structure, very light weight, cast by a special process in thin slabs and used as sheathing and as a stucco base. It is also well rated as an insulator.

Insulation is a problem worth study.

FLOORS

Fireproof floors represent a very important step toward more permanent construction. Fireproof floors are practical only by the use of concrete. While the cost is in most cases more than the cost of a wooden floor, the percentage of increased cost for a fireproof floor over a wooden floor is very small indeed on a basis of the total cost of the entire structure. The con-

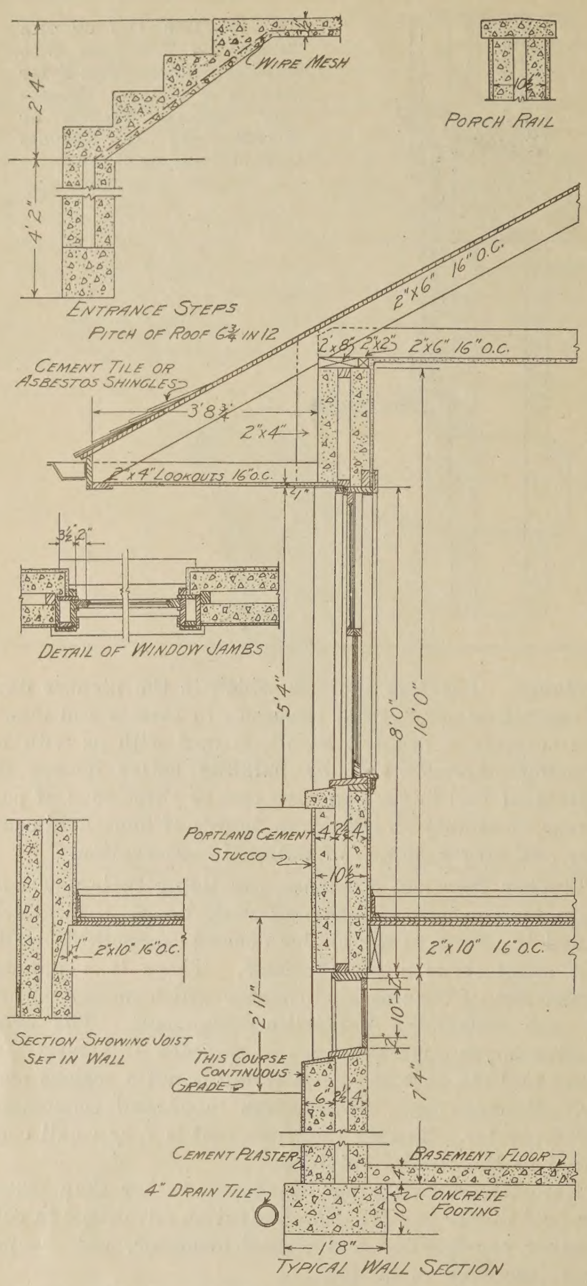
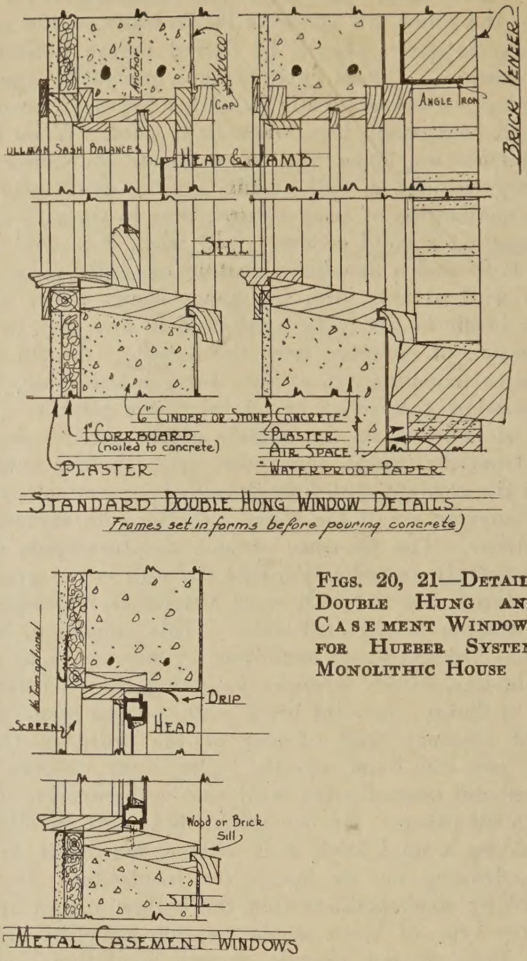


Fig. 20—Details for Van Guilder Double Wall Construction

crete floor slab ties the structure together. It makes it a better structure and it provides fire protection, reduces vibration, is more hygenic and in every way produces a higher type of structure. A good many people have the idea that fireproof floors in their houses would be expensive.

Progress toward the all fireproof home is being made and there is a greater demand all the time for fireproof floors, particularly in the first story, separating the living quarters of the house from the basement with its heating plant. It is possible to finish concrete floors so that the concrete surface itself is an acceptable floor surface—not only acceptable, but very beautiful. Various ways of accomplishing this have been described in this magazine in previous numbers and will here be referred to but briefly.

The concrete floor slab may be finished off with a concrete having a special aggregate which is ground down, giving a terrazzo surface. This takes a high polish. The surface may be a smoothly troweled surface which must be done by good workmen. Such floors may be filled with stain, varnished and waxed, which produces beautiful results. It is common to decorate plain concrete floor surfaces with a border of tile and cover the center of the room with rugs. The use of such floors in hotels and apartment houses is becoming general and their use in private dwellings is increasing. It is possible also to construct the floor with a slightly depressed center area in which linoleum is inlaid. Or if the concrete structural floor is not pleasing to the individual home builder, he may cover the rough slab with a wood floor on sleepers, embedded in or spiked to the concrete while it is fresh. This is a particularly easy accomplishment with cinder concrete.



Figs. 20, 21—Details Double Hung and Casement Windows for Hueber System Monolithic House

The construction of a concrete floor is a subject for separate consideration, together with the experience of

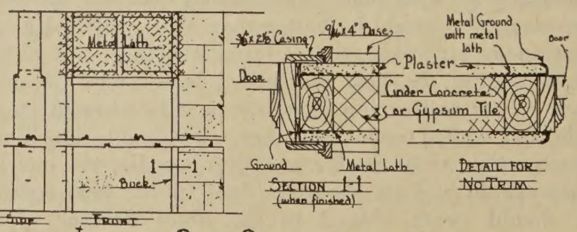

Metal Lath
⅜"x2⅝" Casing
9/16"x4" Base
Metal Ground with metal lath
Door
Door
Plaster
Cinder Concrete or Gypsum Tile
1—1
Buck
Ground
Metal Lath
Section 1-1 (when finished)
Detail for No Trim
Side
Front
Interior Door Detail for Tile partitions.

Fig. 22—Hueber System

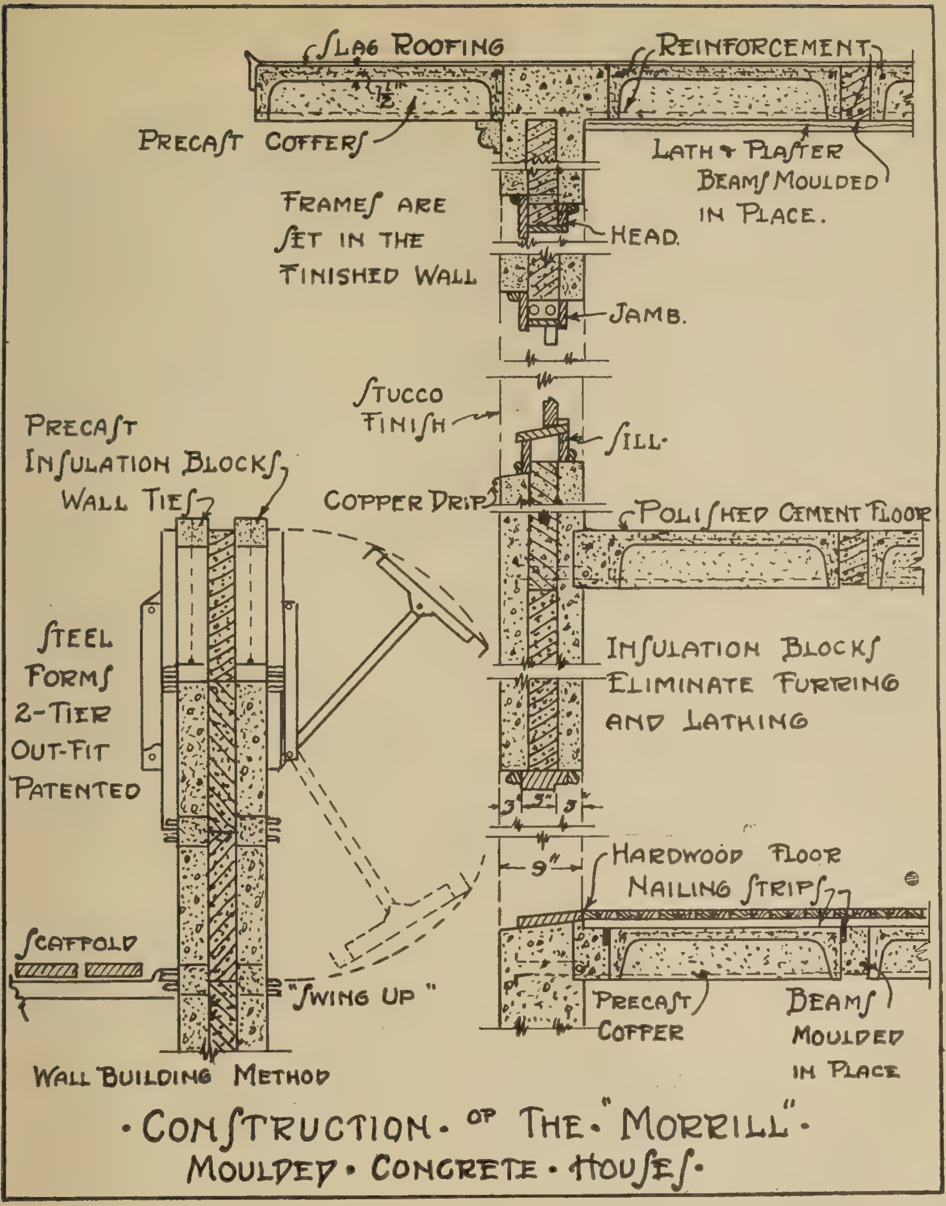

SLAG ROOFING
REINFORCEMENT
PRECAST COFFERS
LATH & PLASTER
BEAMS MOULDED IN PLACE.
FRAMES ARE SET IN THE FINISHED WALL
HEAD.
JAMB.
STUCCO FINISH
SILL.
PRECAST INSULATION BLOCKS
WALL TIES
COPPER DRIP
POLISHED CEMENT FLOOR
STEEL FORMS 2-TIER OUT-FIT PATENTED
INSULATION BLOCKS ELIMINATE FURRING AND LATHING
3" 3" 3"
9"
HARDWOOD FLOOR NAILING STRIPS
SCAFFOLD
"SWING UP"
PRECAST COFFER
BEAMS MOULDED IN PLACE
WALL BUILDING METHOD
• CONSTRUCTION • OF THE • "MORRILL" • MOULDED • CONCRETE • HOUSES •

Fig. 23—Details of Suggested Construction Embodying Several New Features—Contributed by Milton Dana Morrill

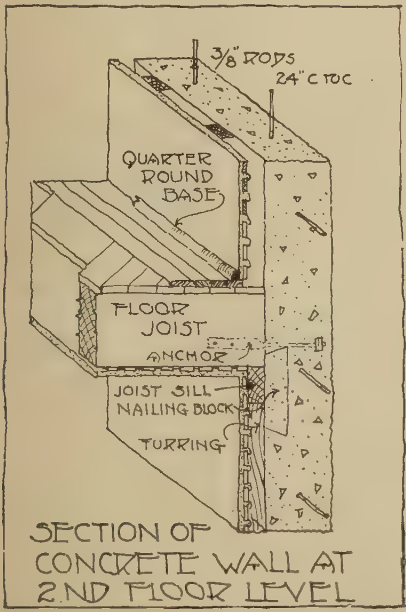


Fig. 24—Wall and Second Floor Section, Morrill System

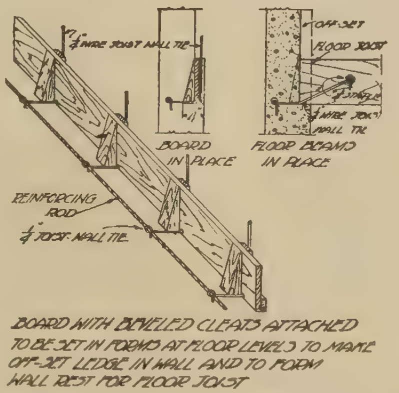


Fig. 25—How Joist Supports Are Provided in Morrill Monolithic Construction

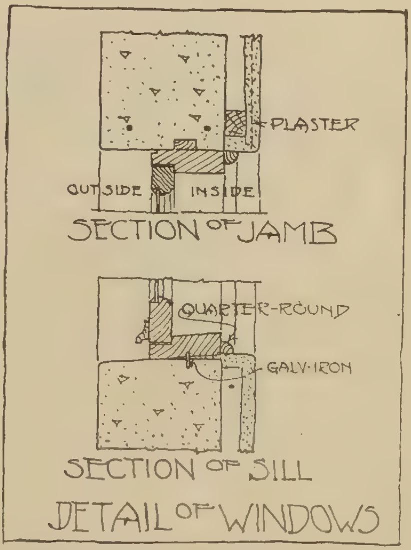
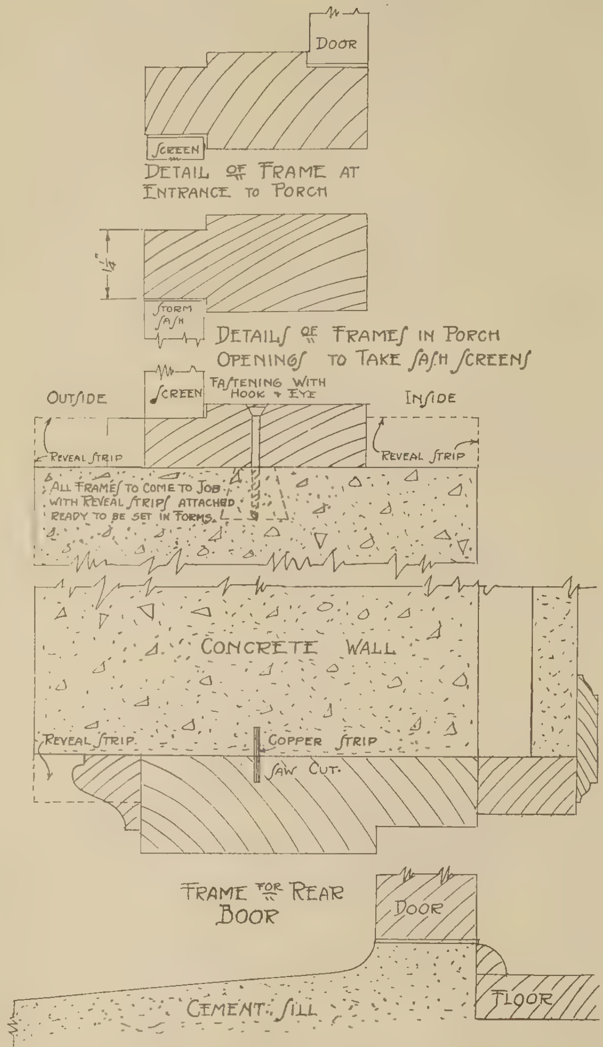
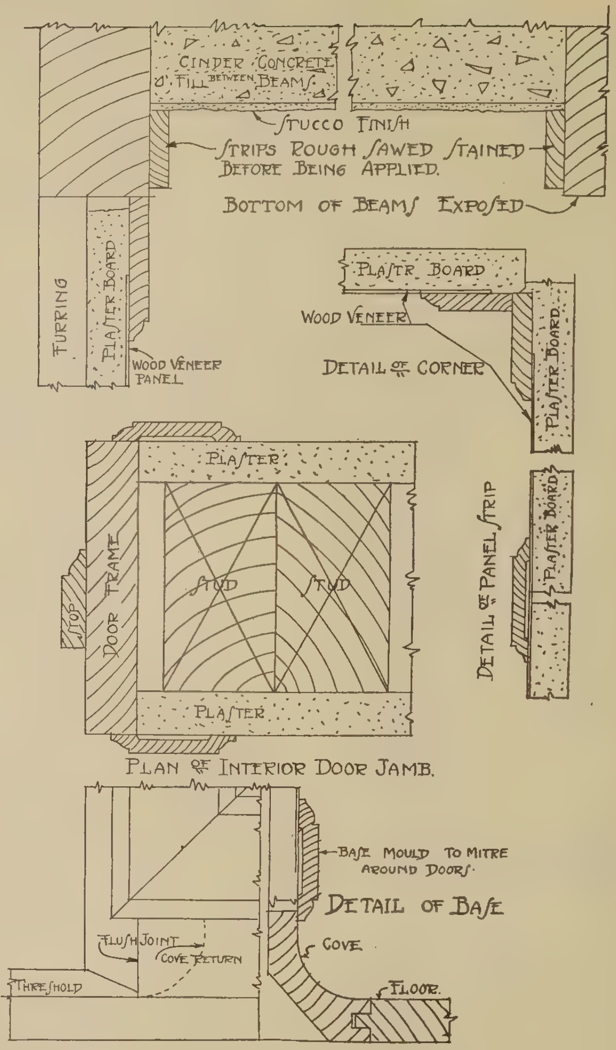
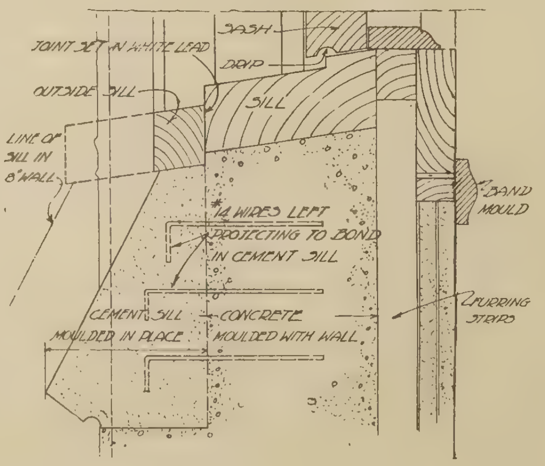
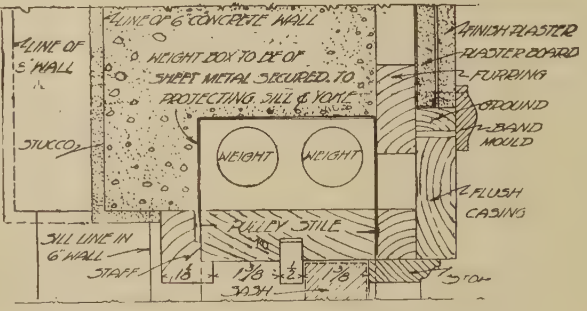


Fig. 26—Window Details Used on Some Morrill Houses

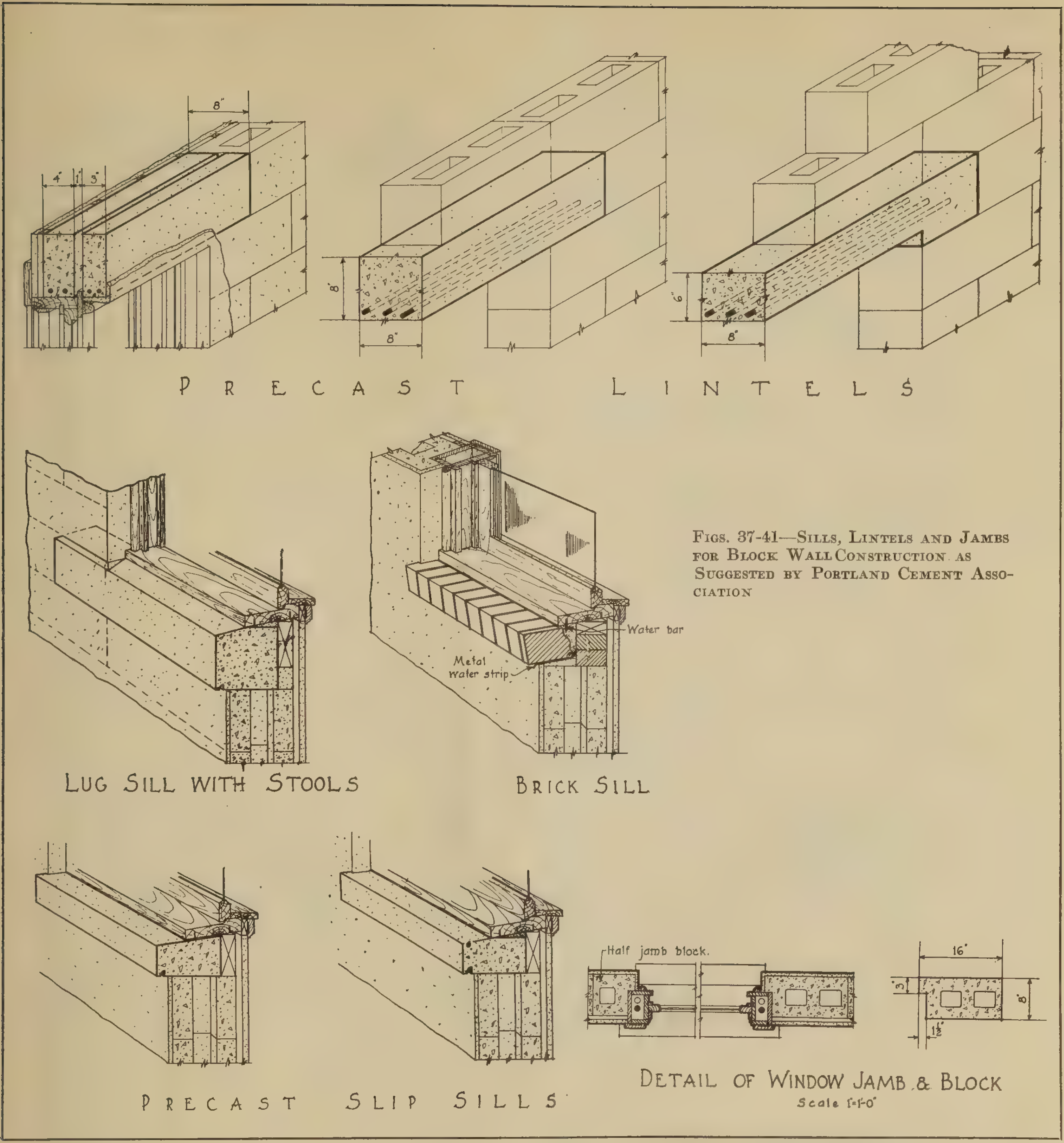

DOOR
SCREEN
DETAIL OF FRAME AT ENTRANCE TO PORCH
1¾"
STORM SASH
DETAILS OF FRAMES IN PORCH OPENINGS TO TAKE SASH SCREENS
SCREEN
FASTENING WITH HOOK & EYE
OUTSIDE
INSIDE
REVEAL STRIP
REVEAL STRIP
ALL FRAMES TO COME TO JOB WITH REVEAL STRIPS ATTACHED READY TO BE SET IN FORMS.
CONCRETE WALL
REVEAL STRIP.
COPPER STRIP
SAW CUT.
FRAME FOR REAR DOOR
DOOR
CEMENT SILL
FLOOR




SASH
JOINT SET IN WHITE LEAD
DRIP
OUTSIDE SILL
SILL
LINE OF SILL IN 8" WALL
BAND MOULD
#14 WIRES LEFT PROJECTING TO BOND IN CEMENT SILL
FURRING STRIPS
CEMENT SILL MOULDED IN PLACE
CONCRETE MOULDED WITH WALL



Figs. 27, 28, 29, 30—Detailing Morrill System House



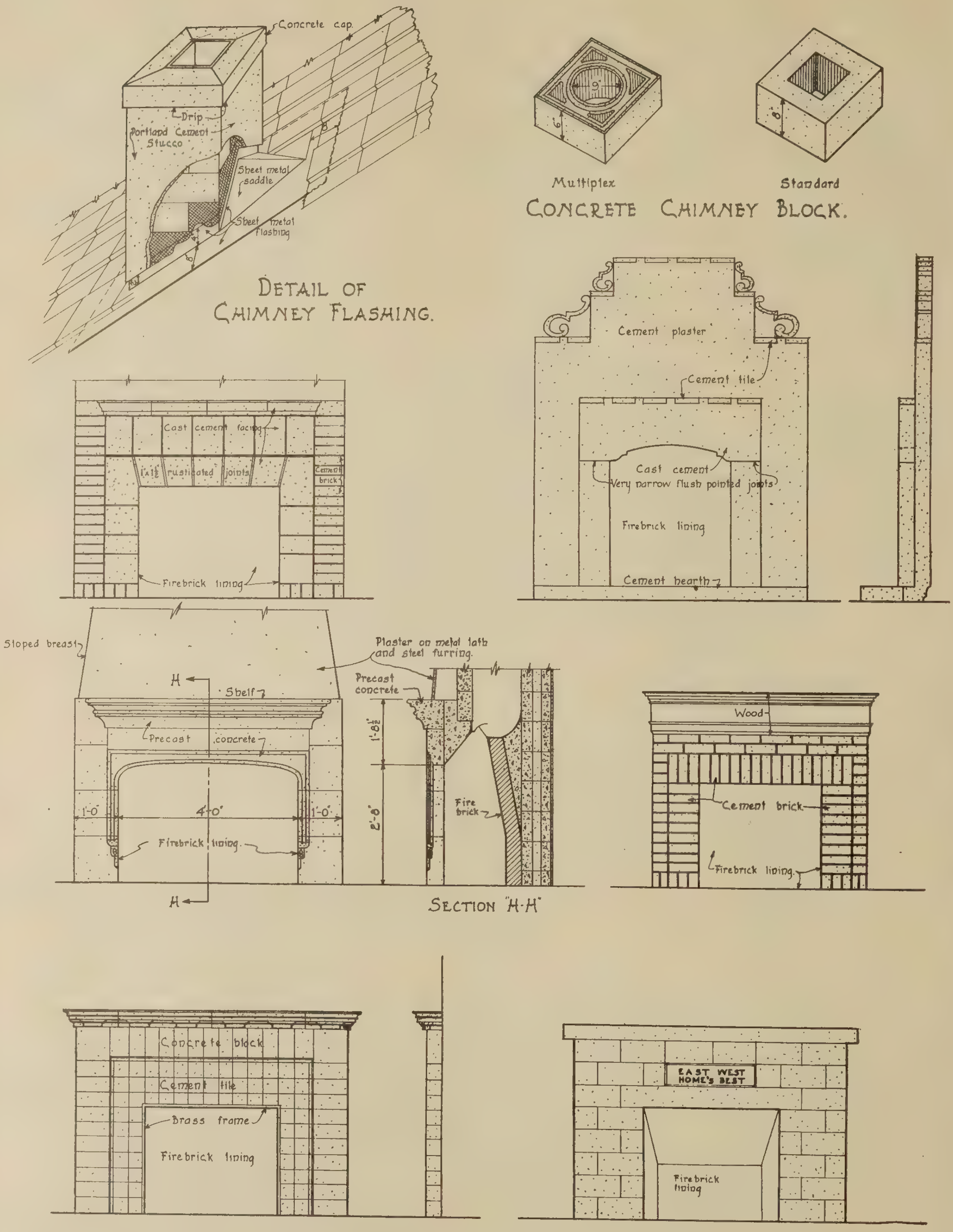
Figs. 37-41—Sills, Lintels and Jambs for Block Wall Construction as Suggested by Portland Cement Association

some builders as to the comparative cost of wood and concrete construction. Concrete floors are a most natural development when the house walls are of monolithic construction, as with the equipment on the ground for building walls monolithically the construction of the monolithic floor is an easy step. It is not, however, a difficult matter even with a house built of concrete units and adds a very small amount to the cost of the structure.

For a long time, however, many houses will continue to be built with wood floors. Wood has prevailed so long that the public will not at once make a change. In ordinary residence construction, the floor loads are light and the joists for wood floors are easily carried on the inner side of the block, or when the combined floor loads, dead load and live load, exceed 60 lbs. per sq. ft. joists are supported on solid block. Sometimes joist courses are used in the construction of block walls, providing a veneer block on the outside, the thickness being a trifle less than half the regular block thickness, and the joist block laid on the inner surface of the wall with openings in which the joists rest. Joist block are usually nothing but plain slabs of such a length as to space the joists properly.

Sills and Lintels

It is desirable in providing sills and lintels which are to be set into the wall that they be of a size to replace exactly a given number of whole or half block. A little forethought in detailing of this kind makes for economy. In the best residence construction split sills and lintels are used; that is, these pieces of special concrete trim are provided in two sections, leaving an air space between the inner and the outer wall of half an inch to an inch. Concrete lintels are, of course, reinforced with steel rods, the rods being ¾ in. to 1 in. from the bottom and lintels should be carefully marked so that they are



ALTERNATE DESIGNS FOR FIREPLACES.

Fig. 42—Fireplaces as Suggested by Portland Cement Association—See Also Opposite Page

Fireplace and Chimney Details

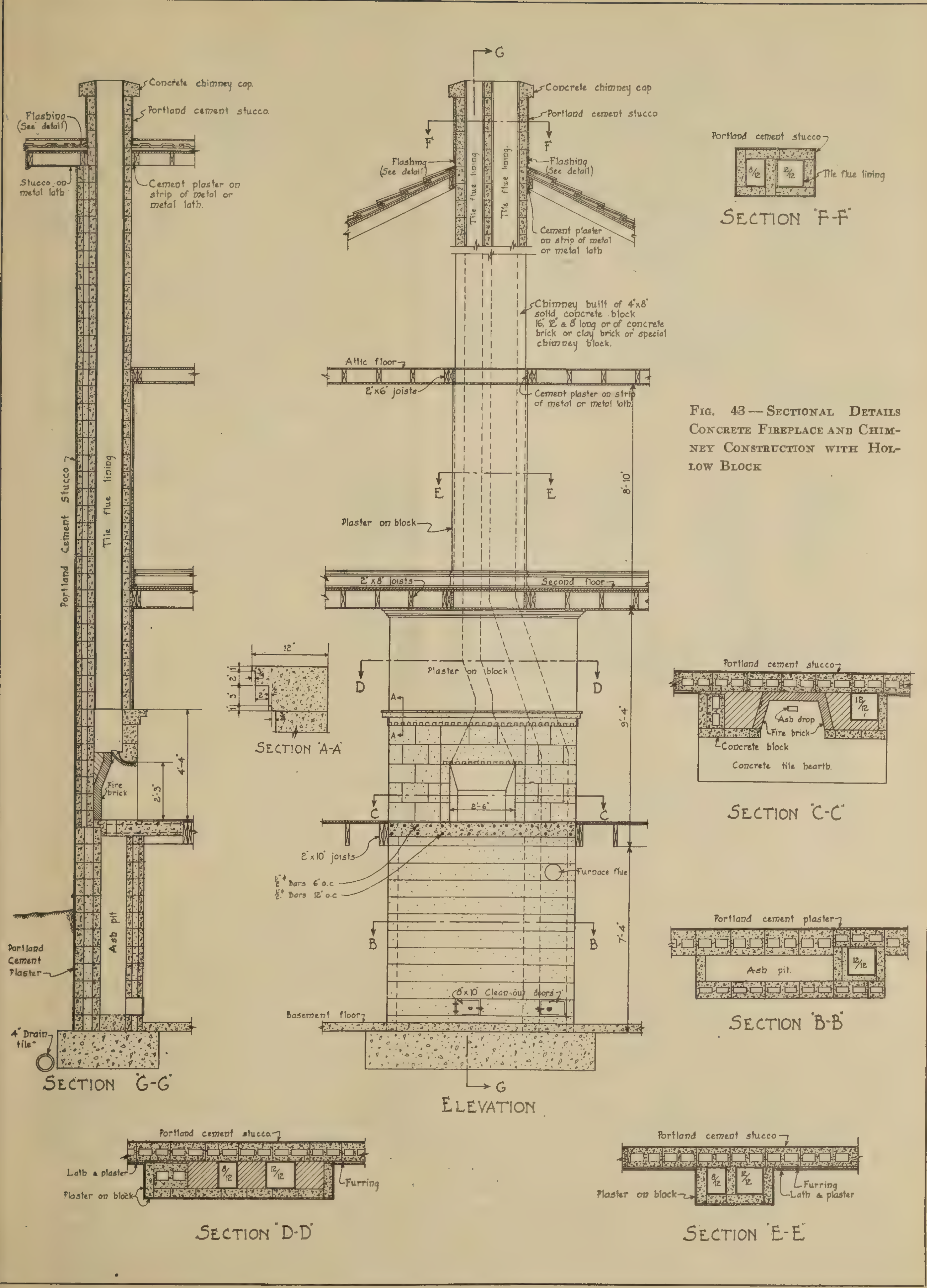
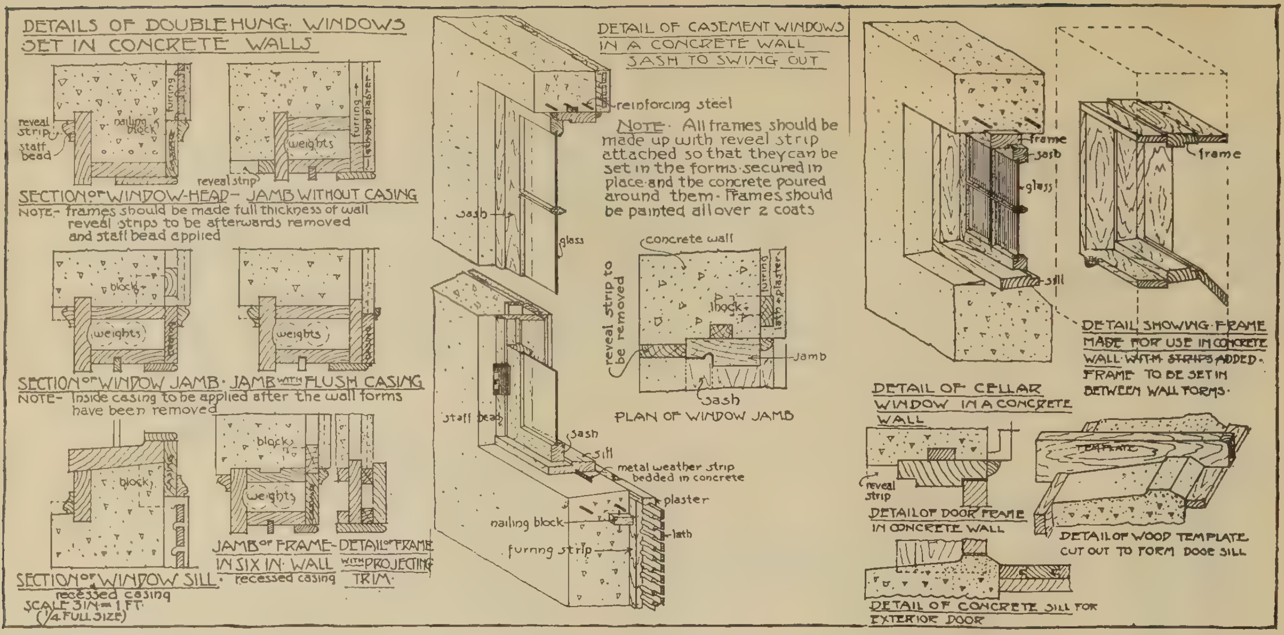


FIG. 43 — SECTIONAL DETAILS CONCRETE FIREPLACE AND CHIMNEY CONSTRUCTION WITH HOLLOW BLOCK


DETAILS OF DOUBLE HUNG WINDOWS SET IN CONCRETE WALLS
reveal strip
staff bead
nailing block
furring
furring
lath and plaster
weights
reveal strip
SECTION OF WINDOW-HEAD — JAMB WITHOUT CASING
NOTE- frames should be made full thickness of wall reveal strips to be afterwards removed and staff bead applied
block
weights
weights
SECTION OF WINDOW JAMB · JAMB WITH FLUSH CASING
NOTE- Inside casing to be applied after the wall forms have been removed
block
casing
block
weights
JAMB OF FRAME- IN SIX IN. WALL · recessed casing
DETAIL OF FRAME WITH PROJECTING TRIM
SECTION OF WINDOW SILL · recessed casing
SCALE 3 IN = 1 FT. (1/4 FULL SIZE)
DETAIL OF CASEMENT WINDOWS IN A CONCRETE WALL SASH TO SWING OUT
reinforcing steel
NOTE · All frames should be made up with reveal strip attached so that they can be set in the forms secured in place and the concrete poured around them · Frames should be painted all over 2 coats
sash
glass
concrete wall
reveal strip to be removed
block
furring
lath + plaster
jamb
sash
PLAN OF WINDOW JAMB
staff bead
sash
sill
metal weather strip bedded in concrete
plaster
nailing block
lath
furring strip
frame
sash
glass
sill
frame
DETAIL SHOWING FRAME MADE FOR USE IN CONCRETE WALL WITH ~~STRIPS~~ ADDED · FRAME TO BE SET IN BETWEEN WALL FORMS ·
DETAIL OF CELLAR WINDOW IN A CONCRETE WALL
reveal strip
DETAIL OF DOOR FRAME IN CONCRETE WALL
TEMPLATE
DETAIL OF WOOD TEMPLATE CUT OUT TO FORM DOOR SILL
DETAIL OF CONCRETE SILL FOR EXTERIOR DOOR

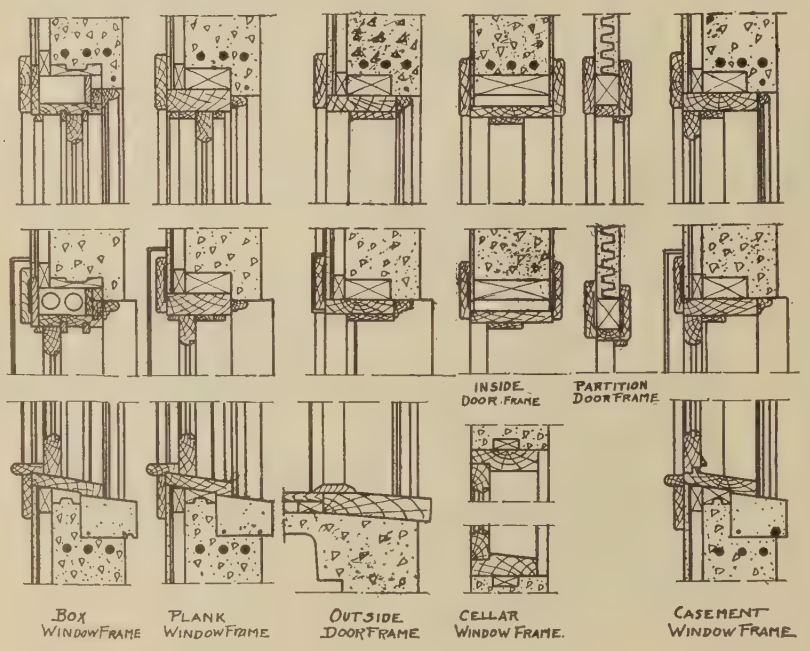


Fig. 43—(Above) Simple Door and Window Details, Suggested by Milton Dana Morrill

Fig. 44—(Left) Details Window and Door Frame Construction for Large Group of Houses at Donora, Pennsylvania

kept right side up with the steel rods at the bottom of the unit.

Cellar Floors

Cellar floors should of course be of concrete, not less than 4 in. thick. It is not enough to put in a layer of gravel or stone or cinders and butter over with a thin layer of cement mortar. A good floor should be 4 in. thick, and should be troweled to a smooth finish which is readily kept clean.

Fireproofing Furnace Room

Where fireproof floors are not provided, furnace room ceilings should at least be fireproof; either there should be a small area of concrete floor in the part of the house immediately above the heating equipment or the wooden joists should be covered on the underside with expanded metal lath and given a fireproof covering of good cement plaster. Tests have shown that this adds very materially to the chance of saving the structure when fire does start from the heating equipment.

All exterior steps and porches which suffer severe wear and exposure should be of concrete, thus eliminating constant repairs and painting, which are necessary in frame structures to keep the work in condition. It is also desirable that bath room floors should be of concrete, rough finished for a covering of tile. It is preferable that such floors should be structural slabs of concrete properly supported. They may be made light, however, by cutting into the joists, putting boards in between, filling up with concrete to a thickness of 3 in. or more, making a good firm level bed for the tile. Expanded rib metal, welded or woven fabric of various kinds are frequently used in reinforcing such floors.

Details

In building concrete houses, many of the details are quite different from other types of construction and such details should be studied carefully by concrete house builders. With this idea of proper detailing of concrete block and of monolithic houses, numerous illus-

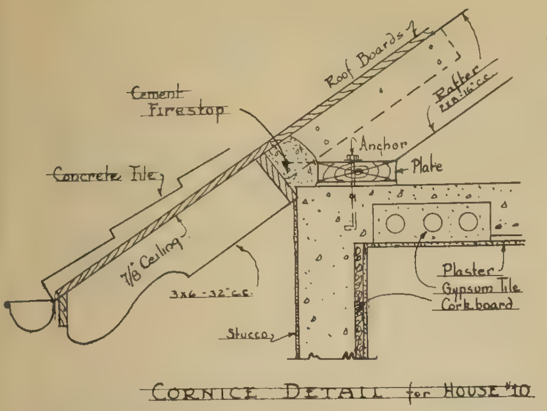


Fig. 45—Used in Hueber House Construction, Syracuse—Note the Fire-Stop

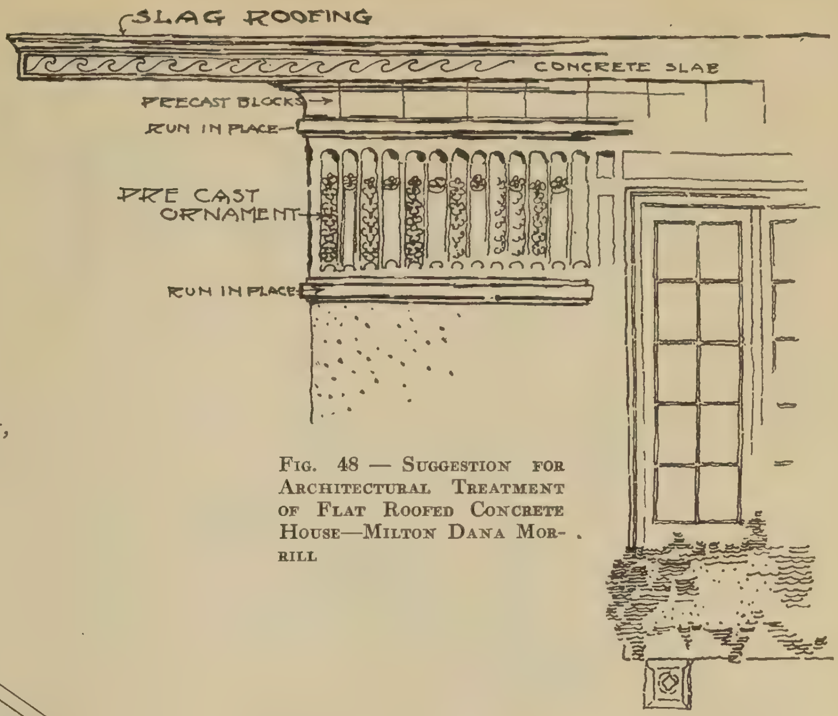
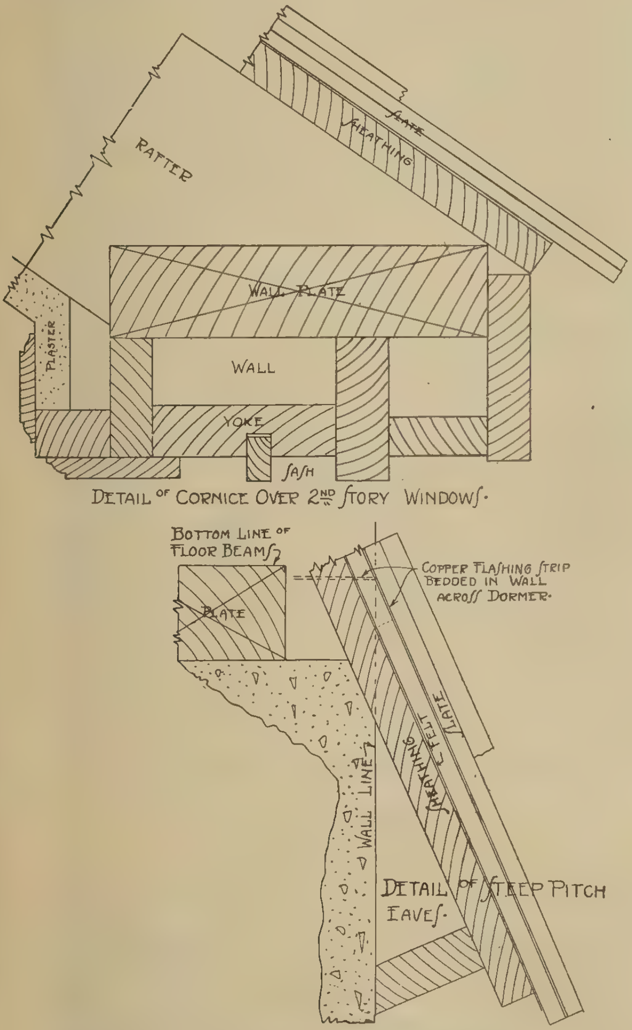


Fig. 48 — Suggestion for Architectural Treatment of Flat Roofed Concrete House—Milton Dana Morrill


RAFTER
SHEATHING
SLATE
PLASTER
WALL PLATE
WALL
YOKE
SASH
DETAIL OF CORNICE OVER 2ND STORY WINDOWS
BOTTOM LINE OF FLOOR BEAMS
PLATE
COPPER FLASHING STRIP BEDDED IN WALL ACROSS DORMER
WALL LINE
SHEATHING
FELT
SLATE
DETAIL OF STEEP PITCH EAVES

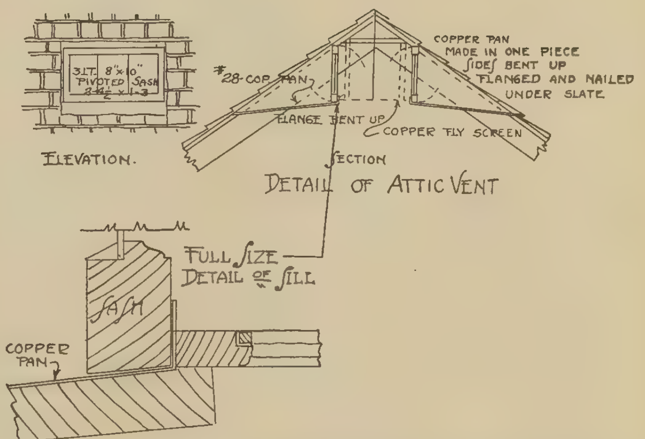
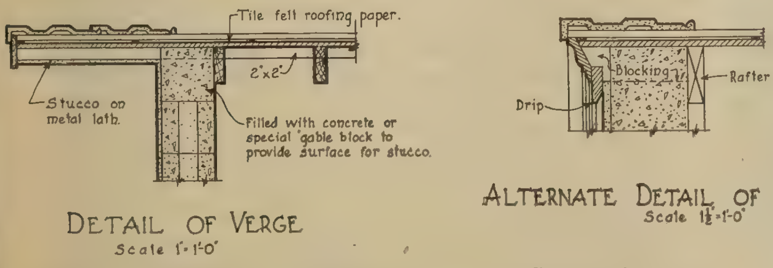


Fig. 49—Morrill Roof Vent Details

Fig. 46—Morrill Cornice and Eaves Details



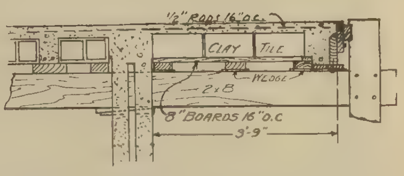


Fig. 50—Flat Roof Overhang—C. D. Gilbert Details

Fig. 47—Verge Details Suggested by Portland Cement Association

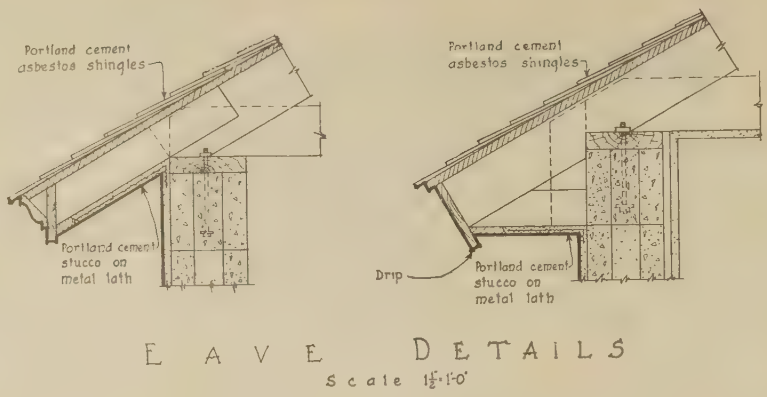

Portland cement asbestos shingles
Portland cement stucco on metal lath
Portland cement asbestos shingles
Drip
Portland cement stucco on metal lath
EAVE DETAILS
Scale 1½"=1'-0"

FIG. 51—PORTLAND CEMENT ASSOCIATION EAVE DETAILS—HUEBER DETAIL ON PREVIOUS PAGE HAS ADDED ADVANTAGE OF FIRE-STOP

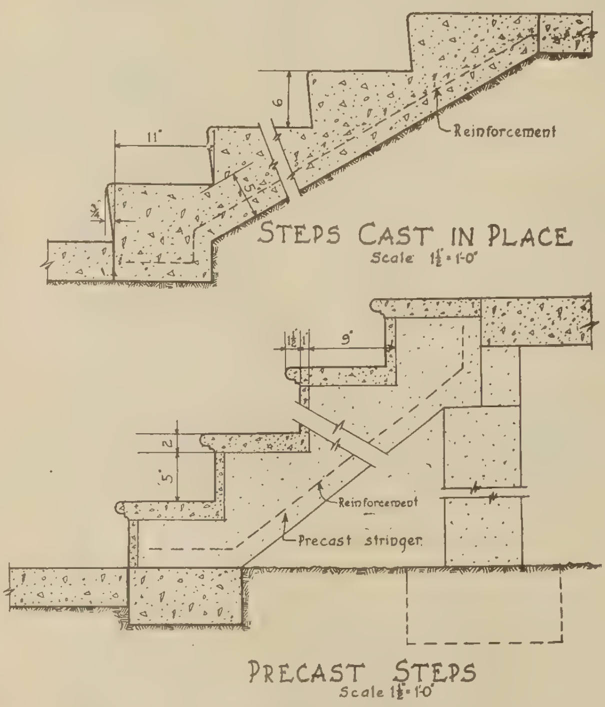


FIG. 52—PORTLAND CEMENT ASSOCIATION DETAIL

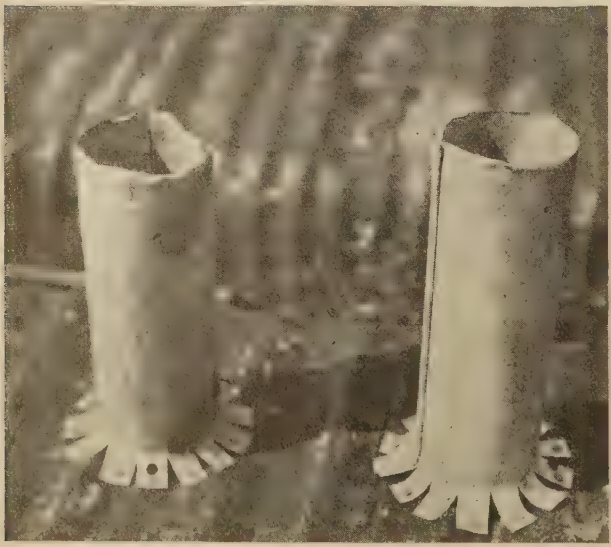


FIG. 53—GALVANIZED SLEEVES SET ON FLOOR FORMS GIVE NECESSARY OPENINGS FOR PIPES

trations are shown along with this article which make clear the proper detailing for concrete block work. For some of these details CONCRETE is indebted to the Portland Cement Association, which is now in a position to supply good plans for concrete block houses. For details used in the construction of monolithic houses, CONCRETE is indebted to Hueber Bros., builders, Syracuse, N. Y.; Milton Dana Morill, architect, New York City; the Van Guilder Double Wall Co., Rochester, N. Y., the Portland Cement Association and others.

Builders of concrete houses who have been successful at this line of work have given a great deal of attention to the proper detailing of windows, doors, cornices and other features. It is not that concrete requires more laborious methods or more elaborate details. In fact it is quite the reverse in many respects. Concrete is a material which may be used with such facility, molded so readily or cast in shapes to meet special requirements so easily, that special details are the natural result, providing more nearly weatherproof construction and greater rigidity and durability. The concrete house details shown here have been worked out by various builders and architects with a thought to making the best use of the material.

Action of Sulfuric Acid on Concrete

BY ERIE J. OCHS
CHIEF CHEMIST, COWELL PORTLAND CEMENT CO.

Concrete for leaching tanks in the copper industry, or in any industry where sulfuric acid is used, will always be an unfavorable consideration. Sulfuric acid attacking the component parts of the cement used in the concrete, breaks them down into sulfates, this action causing the concrete to soften, and go to pieces within a year.

The following are the results of investigation of the action of a 3% sulfuric acid solution on concrete:

	7-da.	28-da.	3-mo.	6-mo.	9-mo.	1-yr.
Standard (1:3) sand briquette (normal)	328	447	503	472	448	458
Standard (1:3) sand briquette, stored in 3% sulfuric acid.	337	415	387	312	127	90
Standard (1:3) sand briquette, gauged with 3% sulfuric acid, and stored in 3% sulfuric acid	320	417	348	292	145	clips

Fireproof Throughout—*The House of the Future, in Which Floors Are the Important Features*

A Symposium

CONCRETE asked some of its readers who have studied permanent house construction closely, each from a slightly different angle, to report comparative costs for fireproof floors and ordinary wood joist floors in small dwellings—houses to sell for about $6,000 with 800 sq. ft. of plan area. This figure cannot ordinarily be obtained for a house of that size, yet Miss Gleason by the use of many short cuts and economies and rigid attention to the matter of minimum cost is building a smaller house and selling it, lot and all, at a proportionately lower price than $6,000. In Syracuse, Hueber Bros. have a different idea. Their aim is to build the best possible house for the citizen of better than average means with more outlay on finish, fittings and special equipment—to sell in competition with the average American house of burnable construction.

Mr. Wilson has been building a few single dwellings every year (no effort at group operation) for buyers who want something distinctly better than average.

Mr. Allen has been a student of housing and housing costs for years and is competent, although not at this time an active builder, to make intelligent comparisons.

All this is frankly offered here as a stimulus to the home owners' demand for better houses—fireproof homes.

Of what use, except as a measure of safety from fire without, is a house with fireproof walls, in which floors are ready fuel for fire from within (where most fires start) and go down in charred wreckage with all the cherished accumulations of the home circle.—Editor.

(The letters which follow were written in July and August, 1922.)

* * *

BY LESLIE H. ALLEN

PORTLAND CEMENT ASSOCIATION, CHICAGO

The cost of a house of fire resisting concrete construction is so little in excess of the cost of the inflammable materials so much in use today that it is surprising that concrete construction is not more largely used for home building.

The biggest hindrance to the adoption of permanent materials of construction is not high cost (because the difference in cost is very small), but the fact that the builder of today who is chiefly engaged in the building of small homes is the carpenter contractor. He is accustomed to execute all the carpenter work himself and to sublet other trades, such as painting and foundations, plastering, plumbing and the like. He naturally desires to do as much of each job as possible with his own forces and to sublet as little as possible—and moreover being chiefly interested in carpenter work he is usually not well informed on the details or the cost of concrete construction and will often tell the client that it is far too expensive, or too difficult or unsuitable.

There is therefore a good deal of inertia to be overcome, even where the home owner is firmly sold on the idea and desires the best and most up-to-date fire resistive construction. He encounters so much resistance when making his trade with the builder that he very seldom succeeds in getting what he wants.

What we need is more energetic salesmanship on the part of the mason contractors and concrete contractors who take the cellar and foundation sub-contracts of the house and the walks and driveways. They could with a little energy, determination and good salesmanship become general contractors for themselves, sell the owner on the desirability and the feasibility of permanent concrete construction in his home at a very slight increase in cost, or failing this they can, as sub-contractors, put it up to the owner by salesmanship and to the public by advertising so strongly as to create an insistent demand for concrete construction.

The difference in cost may be well illustrated in the example, a house of 800 sq. ft. I have assumed that this house will be 25 ft. by 32 ft. in plan, with story heights from floor to floor of 8 ft. in the cellar, 10 ft. first floor, and 8 ft. second floor. Allowing for the slope of the roof, this will give a total cube of 24,000 ft.

Assuming that a house of this kind built today in frame construction, the outside being stuccoed on metal lath and having wood joists and wood flooring, would cost about 25 cents per cubic foot, total is $6,000. If the outside walls were of 8-in. concrete block, stuccoed outside and furred and lathed on the inside, the increase in cost would not be over $200. If instead of this the walls were of 6-in. monolithic concrete stuccoed outside and furred and lathed inside, the increase in cost should not be over $400, total $6,400. This is assuming that suitable forms were available and a reasonable rental only was charged to the job. If wood forms had to be specially built for the job, this cost would be increased by at least $200 more.

(Even when special wood form work must be used, the ingenious builder might cut Mr. Allen's figure by using the lumber to frame and sheath the roof—Editor.)

The substitution of reinforced concrete floors finished in granolithic for wood floors, should not exceed $240, while if the concrete floors had to be covered with a wood top surface on sleeper, this figure would be $400 instead of $240.

Coming next to the roof, the difference in cost between wood shingles and concrete roofing tile would be less than $200, so that for a total sum of $6,640 a house can be changed from frame construction and wood shingles to concrete block walls with concrete floors and a concrete tiled roof—the additional cost being but $640 or 10.6% increase.

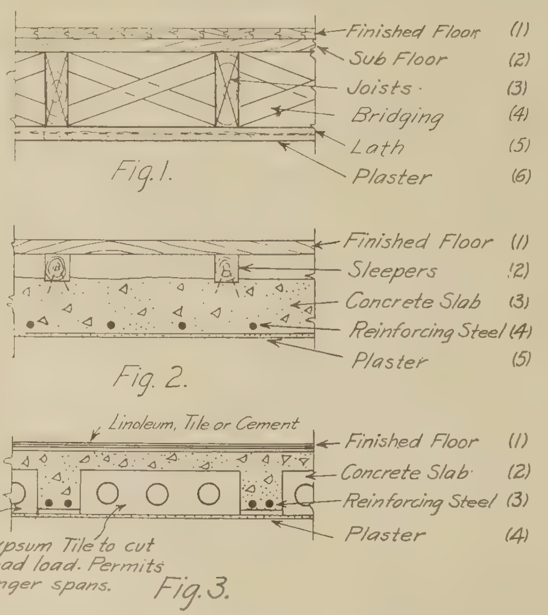
It is hardly conceivable that the owner who has these figures presented to him and clearly explained would neglect the opportunity to secure permanent, maintenance-free construction at such a reasonable cost.

By Paul Hueber

Architect, Hueber Bros., Inc., Builders, Syracuse, N. Y.

I made the accompanying sketch to bring out clearly the simplicity of the floor in Fig. 3 which I believe will, sooner or later, become the popular finish for a concrete slab.

A fireproof floor for a small concrete block house, I believe to be impracticable, as the cost of setting up machinery for mixing, elevating and pouring concrete would be charged against floors only and this would bring the unit cost rather high. Also the blocks would have to be laid by a mason at a high wage rate, while with a monolithic home the floor is a simple problem, and no skilled labor is required for the wall.



Figs. 1-3—Hueber Comparative Floor Sections

We prefer not to give our unit costs as yet as we are trying out changes which may take another year to prove and our labor cost with our forms would be of no value to someone else using ordinary forms or other patent forms. One can figure unit hours from article in January Concrete (1922).

We have not used cement floor finish, but it might interest you to know that in Cleveland, Ohio, cement finished floors are being placed in apartment houses throughout and they are preferred to wood.

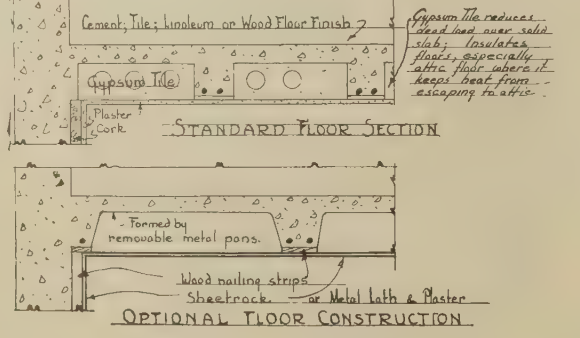

Cement; Tile; Linoleum or Wood Floor Finish
Gypsum Tile reduces dead load over solid slab; Insulates floors, especially attic floor where it keeps heat from escaping to attic
Gypsum Tile
Plaster
Cork
STANDARD FLOOR SECTION
Formed by removable metal pans.
Wood nailing strips
Sheetrock. or Metal Lath & Plaster
OPTIONAL FLOOR CONSTRUCTION

Fig. 4—Another Hueber Suggestion

We find that the sleepers over the concrete slab, which carry the finish floor, about equal the cost of the sub-floor—there being less lumber but more labor. The reinforced slab replaces joists, bridging and lath and if forms are true, less plastering is required.

Linoleum is extensively advertised for home floor finish after general adoption in other types of buildings where there is hard usage.

We use beam and tile (gypsum) floor construction as our forms use spans to 17 ft. and a 5-in. slab of this construction permits a 40-lb. live load in a 17-ft. span.

There are so many people who speak of tile or cement floors being cold and damp, without realizing that there are hundreds of such floors in daily use in luxurious homes with pleasant and satisfactory results.

* * *

By Kate Gleason

Engineer, East Rochester, N. Y.

For a wood floor approximately 33 ft. long by 24 ft. wide which can be supported by bearing partitions so there is no necessity to figure beams, the present price would be approximately 50c per sq. ft. And the floor would be in the neighborhood of 12 in. through.

A concrete floor with columns and beams and an inlaid linoleum top would cost approximately 40c per ft. This would be 4 in. thick, so there would be a further saving of one tread in the stairs and a saving in the height of the walls. I have figured this concrete floor reinforced with ribbed material like Self-Sentering or Hy-Rib and the necessary amount of props and so save the expense of forms for a single job. A form would be needed for the columns and the beam but the expense is included in the 40c.

(It must be remembered that Miss Gleason's costs are based on a very unusual organization—a concrete housebuilding organization which has produced nearly a hundred concrete houses under the supervision of Miss Gleason, who has an almost uncanny keenness for systematizing her construction operations under advantageous labor conditions. She has an organization of home-builders—a trade for which there is a pressing need in America to cut down excessive charges for the employment of a great number of trades—each one constituting an expensive minimum to a house job.—Editor.)

* * *

By Francis F. Wilson

Rockville Center, New York

I build only monolithic concrete dwellings and the following figures are based on my own experience and local prices (non-union labor).

Assume a one family dwelling 800 sq. ft. on each floor. I find a 6-in. structural slab, with 2 by 2 sleepers to hold finish flooring works out the best. My costs are as follows:

22 bbls. cement @ $2.60 net	$ 57.20	
6½ cu. yds. sand @ $1.50	9.75	
13 cu. yds. gravel @ $2.50	32.50	
750 lbs. ½ in. round bar steel @ $2.96	22.20	
120 hours labor forming @ .75	90.00	
65 hours labor placing concrete @ .75	48.75	
25 hours labor stripping @ .75	18.75	
800 sq. ft. 6 in. structural slab		$279.15

Approximately 35 cents per sq. ft.

600 lin. ft. 2 by 2 sleepers @ .02	$ 12.00	
1000 bd. ft. 13/16 by 2¼ oak flg.	130.00	
Labor laying and finishing	80.00	$222.00
		$501.15

The foregoing figures are for a well finished home—I can't build one with 800 sq. ft. to a floor for five or six thousand dollars; the cost here is from $8,000 to $10,000.

If the price must be less, the slab can be finished in one course for about 38 cents per sq. ft. and the occupant can cover it with rugs, carpet, congoleum, etc.

Personally, I think there is no objection to the one course cement finished structural slab, but if you are trying to sell, it is too radical for most buyers, the wood floor finish takes best. Magnesite floorings are also very good but cost more than wood here.

Steel lumber with a 2-in. concrete top and wood floor finish also makes a good fireproof floor; but will cost here, more than structural slab.

My own home is monolithic, slab floors, wood finish except bath, lavatory and sun room, which are cement finish, colored, and my home has yet to have an adverse criticism and a great many have seen it in the last 5 to 6 months. No one has been asked leading questions and all opinions were spontaneous.

The all concrete home is really good throughout, is a quality home in every respect. Its cost is slightly greater than frame construction when built singly, first here and then there; in quantities it can be built at as low a cost as any material.

* * *

By A. H. Bromley, Jr., Mem. Am. Soc. C. E.
Chief Engineer, Building Materials Division, The Berger Manufacturing Co.

Metal Lumber provides a particularly desirable fireproof floor construction for use in monolithic concrete or concrete block houses.

The system embodies the advantages of the simplicity of the wood joist construction, including speed and low erection costs, together with requisite fireproof qualities.

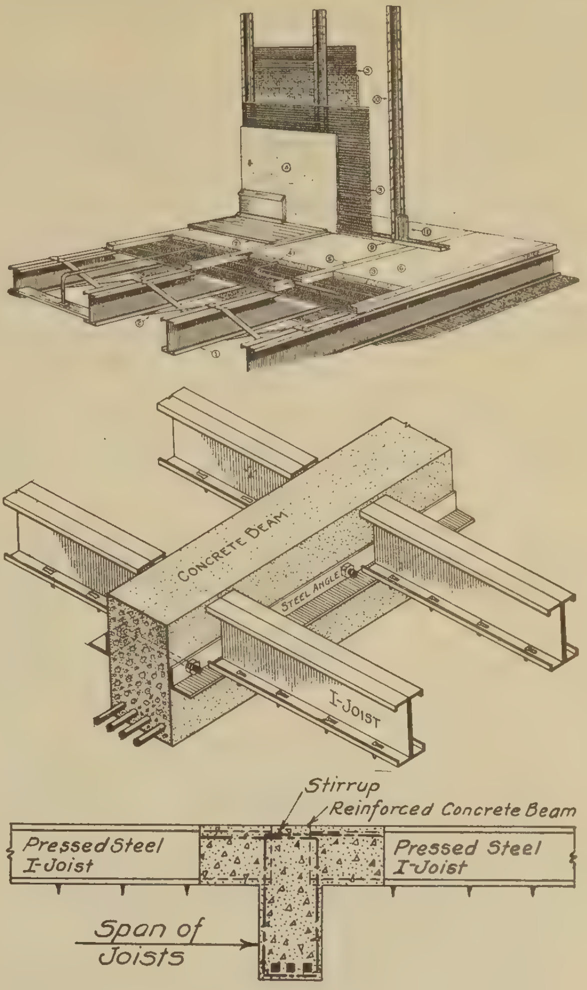
Metal lumber joists consist of two pressed steel channels which are spot welded together back to back, forming I-joists—(Fig. 1). The joists are made of special analysis steel of strength equal to that in rolled structural shapes, are furnished cut to length, and marked for identification to correspond with layout plans which are made by the manufacturer.

The joists (the load carrying members) are fabricated from fire-resistive material and also fireproofed on the upper side by a 1¾ in. concrete fill, and on the lower side by a cement plaster ceiling.

The details of erection are simple and involve but a small amount of labor. The joists are first installed, with bearings 4 in. long on concrete or masonry walls. Where they bear on steel the bearings should be at least 2½ in. long. Like wood joists, they may bear on walls, being either set in pockets or bricked in to the wall.

They may also be suported on top of steel beams, on shelf angles, or on hangers in the usual manner.

Where concrete beams are used the joists may be supported by shelf angles bolted to the concrete beams (Fig. 2)—if T-beams, the joists carry through the flange and extend 2 in. into the web—(Fig. 3).



Figs. 1, 2, 3—Details Showing Use of Metal Lumber in Floor Construction (See Text)

Key—(Fig. 1)—1, Berloy metal lumber I-joists; 2, metal cross bridging; 3, ⅜ in. metal lath; 4, electric conduits; 5, wood nailing strips; 6, concrete fill; 7, finished wood floor; 8, plaster; 9, channel socket strip; 10, channel studs; 11, wood nailing block.

Where the ends are free the joists are temporarily held in position by nailing light wooden strips across the tops of the joists near the supports, after the joists are bridged these wood strips may be removed.

When ready to install the floor finish, ribbed metal lath and 1¾ in. by 1¾ in. nailing strips are in turn nailed to the tops of the joists, the nails being driven down between the two web plates of the joist. The 1 in. wide galvanized strap bridging is nailed to the joists in a similar manner, using 6d nails for the bridging, 1 in. roofing nails for the ribbed lath and 16d nails for the nailing strips. A 1¾ in. 1:2:4 or 1:2½:5 concrete fill is then poured between the sleepers.

The ribbed metal lath serves both as a centering and reinforcing for the concrete fill.

The wood floor is then nailed to the wood sleepers in the usual manner. If wood finish is not used, the sleepers are omitted and the concrete fill is poured in an unbroken slab, and the cement or composition floors laid.

The joists are usually spaced at 24-in. centers, and joists more than 8 in. deep are rarely required in ordinary house construction—this can readily be realized as

5-in. joists will carry house live loads on a 10-ft. span; 6-in. joists on 12-ft. spans; 7-in. joists on 14-ft. spans and 8-in. joists on 16-ft. spans.

The average cost for metal joists, bridging and ribbed lath for the top and bottom of the joists, based on 24-in. spacing of joists, and on summer of 1922 costs is about 20 to 24 cents per square foot. The installation of the joists with labor at $1.00 to $1.25 per hour will cost under usual conditions from 2 to 2½ cents per square foot, and the nailing of the top lath in place about 1 cent per square foot, and installation of ceiling lath 1½ cents per square foot, or a total average cost of joists bridging and lath of from 25 to 29 cents per sq. ft.

The freight and hauling charges are assumed at $10 per ton total, or about 2½ cents per sq. ft.

The labor cost can easily be checked by comparing it with the cost of the erection of wood joists, as the labor involved is very similar, except that the metal lumber joists are cut to length when delivered at the building site.

The cost of the erected wood floor construction can readily be computed by any contractor in the city where the house is to be built, and it will be found that the slight extra cost of the house with metal lumber floor construction, is well worth while because of its fireproof and non-shrinkage qualities.

Recommended Minimum Requirements for Small Dwelling Construction

Investigations by a Congressional Committee during 1919 and 1920 disclosed that existing building laws through variations and inconsistencies of their provisions and through unduly restrictive or expensive requirements, were operating to prevent needed activity in the building industry. That these conditions might be remedied, a committee of experienced architects and engineers was organized by Secretary Hoover, to investigate building practice and code requirements and to prepare standard building regulations based on the latest and best information, which might be recommended to cities and states adopting or revising building codes.

The first report of this committee presents recommendations for the construction of one and two-family dwellings having exterior walls of solid or hollow masonry, concrete, and frame, the latter including veneer and stucco surfaces.[1]

In order that its recommendations might have sound bases of information and opinion, the committee obtained the cooperation of nearly one hundred architectural and engineering societies, builders' exchanges, and industrial organizations producing building materials. Special questions also were referred to large groups of individual engineers, architects, building officials, to the Bureau of Standards, and to others whose experience qualified them to discuss such subjects. Tentative recommendations were drafted and submitted widely for discussion and criticism by those interested in the work, and the final report reflects the influence of this consideration.

The committee recommends that building codes permit 8-in. solid brick and 6-in. solid concrete walls for 2½ and 3-story dwellings, accommodating not more than two families each; that 8-in. hollow building tile, hollow concrete block, or hollow walls of brick (all rolok) shall not exceed 20 ft. in height to the gables; and that frame construction be limited to 2½ stories. Metal lath and plaster on wood studs properly fire-stopped is approved for party and division walls, but at least every alternate wall in row houses must be 8-in. solid brick or concrete or 12-in. hollow building tile, concrete block, or hollow wall of brick.

Requirements for quality of hollow masonry units agree fairly well with present practice, but those for brick are somewhat below the medium grade established by the American Society for Testing Materials. The report recommends revised working stresses for timber used in dwellings, based on investigations of the U. S. Forest Products Laboratory. Live loads to be required as bases for design are 40 lbs. per sq. ft. for floors of wood, and 30 lbs. for those of monolithic type, or of solid or ribbed slabs. Foundation walls of brick are required to be 12 in. thick for excavated enclosures, and similar concrete walls shall be as thick as the walls they support, but not less than 8 in. Special hollow building tile 12 in. thick is permitted for foundation walls of frame buildings. Detailed recommendations are given for fire-stopping and chimney construction; also for treatment of built-in garages.

The recommended requirements are followed by a lengthy appendix containing explanatory material and much educational matter for the guidance of builders, with particular reference to the merits of 8-in. and 12-in. masonry walls, use of lumber, stucco construction, plastering, and other important subjects.

The report comprises 100 pages, including 30 illustrations. The committee is composed of the following members:

Ira H. Woolson, Chairman, consulting engineer, National Board of Fire Underwriters, New York, N. Y.; Edwin H. Brown, architect, Minneapolis, Minn.; William K. Hatt, professor of Civil Engineering, Purdue University, Lafayette, Ind.; Rudolph P. Miller, formerly superintendent of buildings, New York, N. Y.; John A. Newlin, in charge of Section of Timber Mechanics, Forest Products Laboratory, Madison, Wis.; Ernest J. Russell, architect, St. Louis, Mo.; Joseph R. Worcester, consulting engineer, Boston, Mass.

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[1] The complete paper may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 15 cents.

The Siamese Legation

An Example of House Construction With Earley Concrete Finish

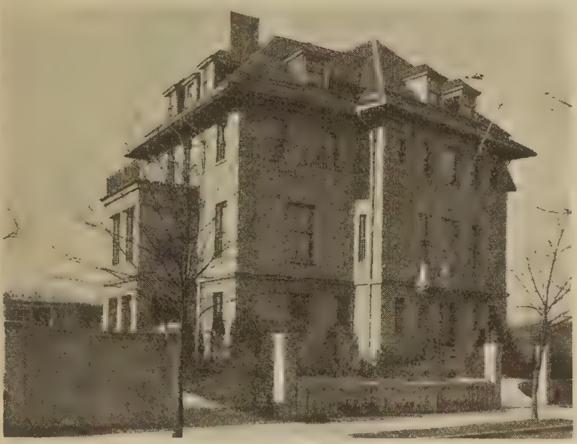


Fig. 1—General View of Siamese Legation

The accompanying pictures show the Siamese Legation, Washington, on which the finish is concrete, done by John J. Earley, architectural sculptor. It is a brick building, and was especially designed and constructed to receive the concrete finish. The brick walls were built in vertical planes from the foundations to the roof plate, with simple openings for the windows and doors. No recesses for panels nor projections for moldings were made in the brick walls.

One of the pictures shows a general view of the building and the balustrade which encloses the grounds. Another shows the central part of the building. A third shows the entrance more in detail, and a fourth a close-up, almost full size, of the surface. The balustrade, including the gate posts, is precast and set; the wall surface was applied with a trowel much the same as is normal stucco, except that the coarse aggregate prevents actual troweling: the material is put in place with considerable pressure and left alone. The balcony brackets and balusters, the second-story pilasters, the door trim and the pots were precast and set; the moldings and rustications were cast in place; yet no difference in color or texture is noticeable, even on close inspection of the work. This is due to the fact that, despite the varying technique with which the material is handled, the result is always the same—namely, the surface is occupied by a very high percentage of aggregate, which is of uniform color and granular arrangement.

The pilasters and brackets for the balcony above the entrance were set, the brackets having been reinforced as for a structurally designed encorblement, but the reinforcing rods were allowed to protrude above the top of the concrete. These pieces were assembled in place in the forms for the balcony, which is properly a reinforced concrete slab, with its reinforcement extending back into the second story floor. The precast balustrade was then set. There is a delicate tracery around the door opening and at the top of the urn. It is remarkable that such delicate relief should receive any expression in such a coarse surface.

The character of the surface shown in the detail, being under nearly complete control, gives color and texture to the building. In spite of its apparent roughness this surface is adjusted to normal vision and on the building when seen from a usual viewpoint, it is a continuous plain surface with a certain character which is highly acceptable, and with a warm yellow buff color, in which the varying colors of the crushed Potomac river pebbles are blended.

Much yet remains to be done in the development of concrete surface treatments. We are, however, encouraged by the promise which present results hold forth. So far the Earley process has improved concrete surfaces in structure and appearance to a degree which deserves the confidence and the support it is receiving from architects. The concrete finish must be understood as applied to and not built into the building, and as occupying a space determined by the architectural sections, and a vertical line one inch back of the normal building line. It is generally bonded directly to the brick base, but where projections occur, reinforcements are built into the wall and attached to longitudinal reinforce-

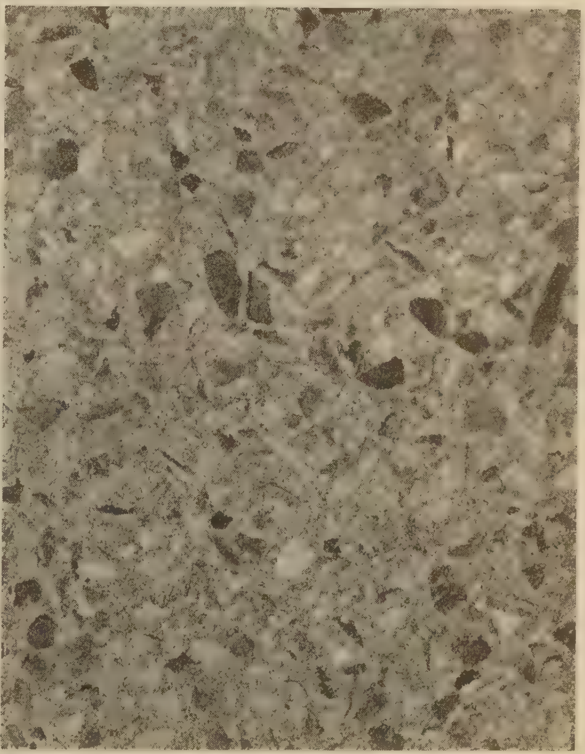
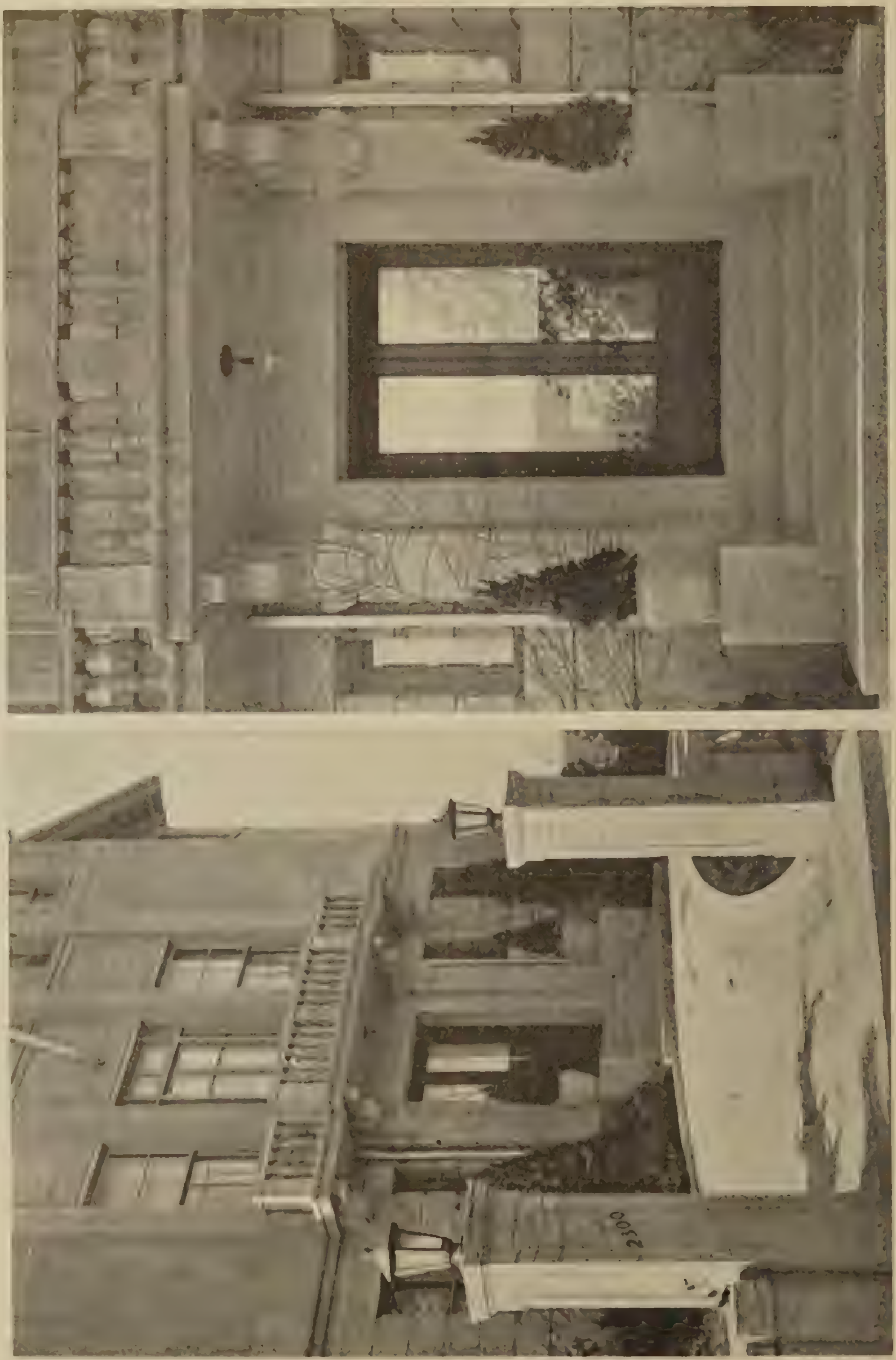


Fig. 2—A Close-Up (Practically Full Size) of the Finish



FIGS. 3-4—DETAILS OF EARLEY PROCESS CONCRETE—SOME APPLIED AS STUCCO; SOME CAST IN FORMS IN PLACE; SOME PRECAST—ALL ALIKE AS TO FINAL RESULT

ments in the projecting mass. This applies particularly to the balcony slab and the molding which surrounds the building at the same level.

The architects on the Siamese Legation are Hornblower & Marshall; the builder, Andrew Murray—both of Washington.

The work done by Mr. Earley in Washington, and such achievements as Lorado Taft's *Fountain of Time* in Chicago (see CONCRETE for December, 1922), are giving to the originator of the Earley process a much-deserved distinction in the field of concrete.

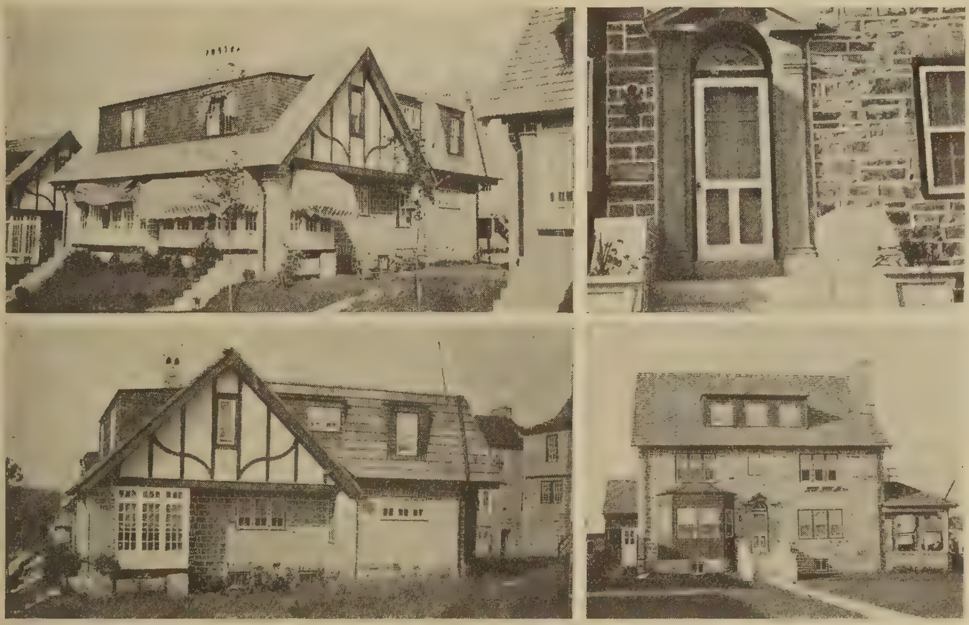
Mr. Earley's success involves, so far as we can discover, no mysterious processes. It is very largely attributable to these things: Mr. Earley is an artist; he is a student who has applied to his work those principles of good concreting which have been developing for years and which are very largely neglected—they are here for anybody to use who has the will to do so; being an artist and a student of good practice, he has studied his aggregates and his mixtures for two results—for beauty in color and texture and for quality and permanence.

He has studied so carefully the results of grading that he speaks in terms of "hundred-foot concrete," "fifty-foot concrete," and so on, which, translated, means a concrete whose grading of sizes and colors in the aggregate produces an effective blend at 100 ft., or 50 ft., or whatever the distance may be.

To the concrete worker who persists in the use of "fine stuff" it cannot be too strongly emphasized that buildings are not ordinarily viewed through a microscope. Use bolder effects in aggregates for beauty, for economy and for permanence. It is happily true that the dictates of *good* concrete are consistent with the requirements of beautiful, characterful concrete. Mr. Earley's color work, the strongest color work in concrete to be seen, utilizes the color of the aggregate and not a mortar coloring. The grading reduces the cement to a minimum, and therefore presents the least dead surface to detract from the color result.

Mr. Earley proposes that concrete buildings be done by the contractor in the rough, absolutely plain; that the economy thus achieved would go a long way toward paying for the architectural treatment with special concrete, applied with such results as cover up the plain brick walls of the Siamese Legation.

Concrete Block and Natural Stone in McClatchy Philadelphia Houses



NATURAL STONE AND CONCRETE BLOCK USED IN PHILADELPHIA HOUSES BUILT BY JOHN H. McCLATCHY — ROOF TILE IS ALSO CONCRETE

NOTE NATURAL STONE IN INSIDE CORNER OF HOUSE SHOWN AT LOWER LEFT

John H. McClatchy, builder of homes, Philadelphia, has adopted concrete block, plain and stuccoed, and concrete trim for a great deal of his work in Philadelphia and environs. The accompanying illustrations show how he is using these materials, sometimes alone, sometimes with natural stone so plentiful in the locality, in the erection of better class dwellings, and still preserving certain traditional characteristics of Philadelphia houses. Mr. McClatchy builds extensively—probably two million dollars worth of houses a year. He has his own block plant—Besser automatic equipment and his own concrete roof tile plant—Domine automatic machine.

Thoughts on Concrete Houses[1]

By J. C. Pearson
Chief Cement Section, U. S. Bureau of Standards

In preparing this paper I have not attempted to cover the general subject of concrete houses, even very briefly, but have confined myself to certain aspects or principles on which one might proceed if he were interested in building himself a good substantial home. I have also treated the subject largely from the structural point of view, wishing to emphasize the thought that the question of appearance and finish should be more completely separated from the structural problem than it usually is. Some of the finest concrete houses that I have seen show little or no evidence that the structural parts are of concrete, but this is largely a matter of personal taste. While I have included a few remarks on interior and exterior finish, I have had the structure itself uppermost in mind.

The relation of the concrete house to the housing problem, the advantages and disadvantages of the concrete house, and general problems in construction, are discussed at some length, the latter perhaps rather more in detail than would interest one who is not somewhat familiar with building construction. The "thoughts" apply particularly to those problems in concrete house construction which are not yet completely and satisfactorily solved.

In order that my treatment of the subject may not be too long, I have confined my remarks to the monolithic and the small unit types of houses, which have been most widely used in the small building operations. What is said does not necessarily apply to the large precast unit house nor to the reinforced concrete frame house, although much of the discussion applies equally well to all types.

The Housing Problem and the Concrete House

The housing problem which became so serious during the war is still with us, although it now presents a somewhat different aspect. From the point of view of the average person interested in building a home, the problem is whether one should invest $10,000 in a house that would have cost about $5,000 before the war, and whether one's need is great enough to warrant his facing the depreciation in values which will come when the index figure for dwelling houses drops from its present high level. The direct result of the existing high prices is that many who would prefer to own their own homes are trying to rent, and outside of apartments, desirable rents are scarce. If the frequently quoted figures of the U. S. Housing Corporation are correct, desirable rents in detached houses will be scarcer still in the future, or else people will have to accustom themselves to paying rentals which amount to 15 or even 20 per cent per annum of the value of the property. The effect of these higher rentals, which will not return excessive profits to the owners, will undoubtedly be to encourage home ownership. Because of the greater investment required in building a home under present conditions, it is necessary to build more permanently in order to safeguard that investment. The prevailing opinion seems to be that the housing shortage will continue for some years at least, and the remedy for this condition is that people should go ahead and build, but be careful to build *well*, so that their investments will be secure, even if building costs are reduced later.

In numerous papers which have been presented before the American Concrete Institute in the last few years we have been told that concrete houses are efficient houses, an opinion which is held by the very great majority of those who have had experience with them. It is important, therefore, that we should consider the concrete house in its relation to the better house program and broadcast the facts regarding its advantages, its practicability, and its further development. Any contribution on this subject should be welcomed, especially if it outlines the construction problems and indicates how these are being solved by architects and builders.

The Chief Arguments for the Concrete House

For convenience I shall refer frequently to the all-concrete house, meaning by this a house which has its structural walls, floors, and main bearing partitions of concrete, regardless of other materials which may be used in the exterior or interior finish. The outstanding advantages of such a house are four:

1. It is more sanitary than any other type affording less opportunity for vermin to find thoroughfare or breeding and hiding places.
2. It is a very fire-resistive type of construction.
3. Its maintenance and depreciation are low.
4. It is of maximum stability and rigidity.

These advantages are fairly self-evident and I have no comment to make on the first, nor on the second, other than to mention the regretable fact that our people are so indifferent to fire risk. Fire-resistive construction in dwelling houses is inseparably a part of the new order of building; in the all-concrete house we can have the highest degree of fire resistance.

The average person may, however, be less impressed by the usual arguments for fire-resistive construction than by a few simple figures which illustrate the meaning of reduced maintenance and depreciation charges. It is fairly well established that a proper maintenance and depreciation allowance for frame houses is about 5 per cent per annum of the total cost. An all-concrete house, we are led to believe, can be built at a cost not greater than 15 or 20 per cent above that of a frame house on substantially the same plans, and the maintenance and depreciation allowance on this type is estimated at about 2.5 per cent. Neglecting taxes and insurance, which about offset each other in these two types, the annual carrying charges for the frame house are interest, say at 6 per cent, and maintenance and depreciation, 5 per cent, total 11 per cent. For the concrete house the charges are 6 per cent and 2.5 per cent, or 8.5 per cent. Assuming the cost of the frame house at $5,000 and the concrete house at $6,000, the annual carrying charges, exclusive of taxes and insurance, are $550 and $510 respectively. Thus the more expensive house proves to be the better investment, for the annual savings, although small, are sufficient to offset the increased first cost in about 16 years, or slightly less than the period set by many building and loan associations for repayment of building loans. If the difference in the first cost had been 15 per cent in the example given, the period necessary to offset this amount by the annual savings in carrying charges would be less than 10 years. The thought I wish to emphasize here is that the first cost should not be the determining factor in the purchase or building of a home, and that if one were required to pay even 25 per cent more for an all-concrete house he would find it a better investment in the safety, comfort, and satisfaction of living in a home that was practically safe from fire, and free from many of the faults that develop in the ordinary house.

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[1] Courtesy *American Concrete Institute*—Advance publication, Copyrighted *Proceedings*, Vol. 19, 1923.

The fourth argument for the concrete house, maximum rigidity and stability, is a most important one, for these are the qualities upon which low maintenance and depreciation depend. Rigidity and stability of the frame do more than this, however, for they not only tend to preserve the house in its original condition, but they save the house owner and house keeper from continual worry about the unsightly appearance of cracks in the plastering, the separation of baseboards from floors, the annoyance of sticking and non-latching doors, sags and humps in floors, and other ills of like nature.

The Chief Arguments Against the Concrete House

There are certain disadvantages of the concrete house which we must recognize at the present time, even though they are not all to be regarded as such in the future. Bearing in mind that we are discussing the subject from the point of view of the prospective home-owner, we may list the following objections in the order of increasing importance:

1. Prevalence of opinion that the concrete house is likely to be cold, damp or unattractive in appearance.
2. Higher first cost.
3. Building Code Restrictions.
4. Lack of builders who are interested or experienced in this type of construction.

The first of these objections is valid only to the extent that one may be unfavorably impressed by certain existing examples of concrete housing which, in the endeavor to find a place in a cheap competitive market, have suffered from the omission of essentials, not only in finish, but also in proper wall insulation. The problem of insulation is not different from that of any masonry house, and in fact there are several systems of concrete house construction which provide the necessary insulation within the wall, a provision which is not as successfully and easily accomplished in any other type of rigid construction. It is true that there are many ugly examples of concrete houses, but the most of these are to be found in commercial and industrial housing projects, where pleasing finishes are deliberately sacrificed to cheapness and utility. This first objection is, therefore, not founded upon fact, and does not need to be seriously considered. A concrete house may be made as attractive as any other, and in fact has possibilities of its own for distinctive treatment.

The second of these objections, higher first cost, is unfortunately too often the deciding factor in the building or purchase of a home. It has been shown, however, that the additional expense entailed in building with concrete is a wise investment, as it means a saving in the end and carries always certain advantages in the nature of a direct return. The higher first cost is not, therefore, a valid argument against the concrete house, for it is the justifiably higher price of a better product. But there is a real objection to higher first cost when this includes a premium upon the ignorance or inexperience of the builder. This is a condition which has to be faced during the introduction of new methods and processes in building, and we must recognize that *too high* first cost is a real obstacle to building these better concrete houses.

Present building code restrictions are in many cases a very serious handicap upon concrete houses, especially those of the monolithic type. At the present time the Federal Department of Commerce is striving to eliminate waste in industry and building construction, and it is gratifying to note the progress which is being made in cutting out unnecessary restrictions governing the thickness of masonry walls in houses. It is particularly gratifying to note the recognition of various types of concrete house construction in the recommendations of the Department's Building Code Committee (Recommended Minimum Requirements for Small House Construction), which also embodies suggestions substantially in agreement with the recommendations of the American Concrete Institute's Committee S-5, on Reinforced Concrete Houses. If the general provisions of this departmental report are made the basis for small house requirements in city building codes throughout the country, one of the great obstacles to efficient concrete house construction will be removed. I wish to emphasize the thought, however, that until these changes are generally introduced, the concrete house will be handicapped by traditional requirements which have been imposed upon older and inferior types of construction.

The greatest disadvantage of the concrete house at the present time is that comparatively few builders have had any experience in building houses of concrete. The majority of small builders will not take the initiative in this matter, and will wait for a general demand to be created before they become sufficiently interested to inform themselves regarding efficient methods, but I believe it is ultimately through the efforts of progressive builders, and not through promoters, that the concrete house will come into general use. The architect will also contribute his share in this development, but it is the associated architect and builder who will eventually solve the individual concrete house problem. We have the basis for a great many possible solutions of this problem in the multiplicity of "systems" of concrete house construction, but none of these can be accepted as a real solution until it has been thoroughly tried out and kept going with increasing momentum for a period of years.

Construction Methods and Problems in Building the Concrete House

To get the full benefit of concrete in house construction it is desirable that walls, floors, and at least the main bearing partitions be built or framed in concrete. At first this sounds somewhat radical, but we are well aware that larger structures such as hotels, apartments, and public buildings are economically built of reinforced concrete, and there is no reason, *a priori,* why this same sort of construction cannot be extended to small structures, such as dwelling houses. This has been done successfully in large operations, but in very few cases extended to individual homes. One of the chief reasons for this state of affairs is that special equipment and knowledge are required by the builder, if good concrete houses are to be built at a sufficiently low price to create a general demand. At the present time there seems to be more equipment available than knowledge, but neither equipment nor methods have been worked out on sufficiently broad lines to indicate clearly how the individual concrete house will eventually be built. The intrinsic merit and superiority of the all-concrete house warrant, it seems to me, encouragement of effort not only on the further development and standardization of this type of construction, but on a broad program of research and education, in order that the product may become more generally available at a cost which will be attractive to people in moderate circumstances.

In the face of many difficulties in selling the all-concrete house, we see many promoters of concrete construction making more or less headway with houses constructed partially of concrete, in which the particularly expensive item of structural concrete floors is omitted and the concrete in most cases confined to the exterior walls. While the concrete-walled house lacks much of the intrinsic value of the all-concrete house, the gradual introduction of the latter may perhaps best be brought about by getting the public accustomed to the idea of the cheaper concrete houses and eventually to the general acceptance of full-fledged concrete houses in this manner. Thus we may congratulate the Portland Cement Association in recently establishing a Concrete House Service Bureau, even though the recommended concrete block or tile wall construction is only the first step toward the really superior all-concrete structure.

With particular reference to the concrete-walled house, whether it be of the small unit or monolithic type, a warning should be sounded against over-rating either the fire-resistive quality, or the expectation of low maintenance and depreciation, if the interior framing is of wood. A very large proportion of all fires originates on the premises where they occur, about 95 per cent of the entire number, I believe, or about 83 per cent on the basis of total fire losses. The mere fact of an exterior wall of concrete or masonry does not, therefore, have much effect on the fire hazard in a dwelling house, although liability of total loss may be lessened thereby. Insofar as maintenance is concerned exterior walls of concrete reduce the cost of exterior painting considerably, but if the interior framing, particularly of the main bearing partitions contains any appreciable amount of horizontal wood, the plastering and the general interior condition are likely to be in worse shape after a round of seasons, and at all times subsequently, than in a well-built frame house. It is most important, therefore, in building the concrete walled house, to take all the precautions for fire protection of the interior that are recommended for wood-frame houses, and to make special effort to eliminate horizontal wooden supports in the bearing partitions. If specifications for concrete-walled houses include the additional requirement that main bearing partitions shall be similar to the exterior walls, or of equally rigid construction, the interior of such houses will be maintained in better condition than will be possible if the interior framing is entirely of wood.

WALLS

The ordinary concrete wall, whether monolithic or of the small unit type, needs insulation of some sort, even in moderately severe climates. The most common practice is to fur with wooden strips and lath and plaster the interior. Certain types of concrete block are designed to give a continuous air space and this avoids the necessity for furring and lathing. The same result is accomplished by the monolithic double wall, and so far as our present information goes, any type of wall that presents two air-tight layers of solid material separated by an air space offers a sufficient barrier to the passage of heat to make an acceptable dwelling house wall. If these layers are connected by webs or cross ties of metal, concrete or masonry units, which form any considerable percentage of the wall area, the insulating value of the remaining air space is largely ineffective, hence the necessity for furring and lathing walls of concrete block and tile. In the case of the cinder block or the monolithic cinder concrete wall, a dry pressed or dry tamped mix may be a sufficiently poor conductor of heat to warrant omission of furring and lathing and if at the same time the necessary strength is obtained, this type of construction may afford a double measure of economy. At least one other type of wall is worthy of mention, and that is the thin solid slab lined with a good insulator, such as cork board or fibre board. This method of insulation promises to be economical and effective and if it permits of satisfactory interior finish, which is independent of wall plaster, it will be a strong point in favor of the small monolithic house.

There is little exact knowledge, however, concerning either the absolute or relative heat transmission of different types of walls; the problem of determining this property is much more complex than it appears to the layman. It is hoped that the Bureau of Standards will, within the next two or three years, be able to carry out a comprehensive investigation of this problem, and it is gratifying to be able to report that preliminary tests on a limited number of typical wall sections have already been undertaken, mainly to establish the methods which should be used in carrying out such a series of tests.

FLOORS

The problem of floors in the concrete house, or in any type of brick or masonry house that is so built as to qualify in the vermin-proof, fire-resistive, low-upkeep class, is the most important and the most serious of any that we have to solve at the present time. Moreover, it is an economic problem entirely, and consequently of greatest importance in its relation to the moderate priced home.

In suggesting the propriety, and from an advanced point of view, the necessity, of putting concrete structural floors into the concrete house, we must recognize the fact that people are accustomed to wooden floors, and until they are educated to a different point of view, will generally demand them. But a concrete slab of standard design, with wooden top floor and a space underneath for pipes and conduits, is a very expensive type of floor, too expensive in fact to go into any but high-priced houses. It is found, however, that the elimination of the wooden top floor and the exposure of a few pipes, which should not be laid in the structural slab, reduce this cost very considerably. Many people have tried the plain concrete floors and find that there is much less objection to them than most people imagine. Rugs and other coverings may be used on the concrete floor with just as much satisfaction as on the wooden floor. But even so the standard flat slab floor is too expensive, and if built according to recommended practice it affords an absurdly large margin of safety. The reason for this seems to be that present standard design does not apply satisfactorily, that is, economically, to the low-load, short-span conditions prevailing in most dwelling houses. There seems to be something fundamentally wrong with a floor design which involves a dead weight from two to four times as great as the maximum live load the floor will ever be called upon to carry.

There are two possible solutions for the concrete floor problem. One is that by some ingenious scheme an acceptable design can be found where the forms or the reinforcement, or both, may be made to serve a double purpose. A scheme of this sort was described in the paper by Mr. H. Whittemore Brown before the American Concrete Institute a year ago, but the method used by Mr. Brown would not be generally applicable. The other solution is to thoroughly test out some new designs that promise to meet these special small house requirements. Certainly there are not lacking a multitude of suggestions for such designs. I believe there are a number of ways in which this problem of concrete floors for small houses can be worked out satisfactorily, but after all, what we need is facts, not beliefs, and the sooner these facts are established, the sooner can the small concrete house be built at a cost comparing favorably with that of the frame house. There is nothing more essential than such a series of tests to the building of better houses at lower costs.

The Bureau of Standards would like to undertake this investigation. It has the necessary facilities and part of the technical staff. Unfortunately, the funds appropriated by Congress are not sufficient to enable it to employ the remainder of the staff and the skilled mechanics needed. However, it can accept the cooperation and assistance of interested organizations and would welcome such cooperation at this time to enable it to work on this problem. It may be stated that other interests, among them the Brick, Hollow Clay Tile, Architectural Terra Cotta, Limestone, Lime, and Gypsum Associations have taken advantage of these conditions, and have placed men at the Bureau to assist in working out certain problems.

The cost of the proposed series of tests would not be at all prohibitive. There are so many large groups vitally interested in the results of such an investigation, that a small fund appropriated by each for a cooperative research would permit the carrying out of a well rounded and conclusive investigation.

In the meantime there is a possible compromise between the concrete floor and the wood joist floor in the use of light weight pressed steel beams. Somewhat more than a year ago I had an opportunity to inspect the steel lumber and stucco house in Canton, Ohio, built by the Berger Mfg. Co. of that city. I was particularly interested in the floor construction, which seems well adapted to any type of concrete house because either wood or concrete top floors can be economically used. The construction which appealed to me as meeting most of the requirements was steel joists of suitable dimensions overlaid with two inches of concrete and protected underneath with metal lath and plaster. If the wood top floor were desired, nailing strips would be fastened to the beams before placing the cinder fill, and the wooden floor nailed in the usual manner. I am indebted to the Berger Mfg. Co. for an estimated cost per square foot of this latter type in place and ready for the wood floor, at 36 cents per sq. ft. This is for a floor of 14-ft. span, carrying a live load of 30 lbs. per sq. ft., the weight per sq. ft. of finished floor being given as approximately 35 lbs. I do not know how extensive the data are on which the performance of these floors is based, but the type should certainly be included in any comparative series of tests, such as the Bureau of Standards will undertake if those interested will cooperate to the extent of providing part of the funds required.

PARTITIONS

The main bearing partitions of the concrete-walled house should be of rigid construction. The choice would naturally be concrete building units when these are used for exterior walls, but steel or reinforced concrete beams, monolithic concrete or any suitable type of masonry may be selected that will prove most economical for the plans. In the all-concrete house or in the concrete-walled house with rigid main bearing partitions and protected steel lumber floors, minor partitions can economically be framed in wood. Not more than 4 in. of horizontal wood is required for the two nailing plates, and the shrinkage or distortion would probably not be great enough to result in appreciable deterioration. Metal lath is preferable for such partitions, and wood-top floors, if used, should be laid after the partitions are framed in place.

ROOFS AND PORCHES

It seems to me that the roof and porches of an all-concrete house, in the sense that I am using the term, need not be constructed of concrete, although concrete can often be used to advantage in both. The point of view is that the chief structural parts of a house cannot be built of better material than concrete, and if the rough structural shell has been properly designed and constructed, the chief advantages that concrete has to offer have been assured. The main purpose of the roof is to protect the dwelling and its occupants from rain, snow, heat and cold, and also to afford an acceptable architectural treatment. Whether the space between the roof and the living quarters is simply an air space or utilized for storage purposes, its construction in wood frame would be entirely consistent, provided it were covered with incombustible roof covering and fire-stopped at the eaves. An added safeguard would be provided by covering the rafters with metal lath and plaster, and this would be desirable in any case for insulation purposes, making the house warmer in winter and cooler in summer. With these precautions the roof framed in wood or metal lumber should be entirely acceptable, and for a number of reasons should be preferred to a concrete roof.

If the occupied rooms are partially enclosed within the roof space and are not entirely separated by fire-resistive construction from the spaces enclosed by the roof, all the precautions mentioned in the preceding paragraph are desirable and necessary, if the dwelling is to be consistently fire-resistive throughout.

In porch construction concrete is to be preferred for the floor, but personal taste and architectural preferences may dictate the use of other materials, especially for the super-structure. There is no objection to such construction if on account of expense or for other reasons the all-concrete porch is not desired.

INTERIOR FINISH

The time is coming when we shall see radical changes made in the methods of finishing the interior walls and partitions of dwelling houses. Many hold the opinion that the practice of applying wall plaster by hand is gradually to be superceded by better and more satisfactory methods. We are led to believe that plain white walls and ceilings will give way to fabricated coverings of various sorts which can be arranged in attractive panel effects avoiding the mess which the plasterer leaves behind him and the delay occasioned by waiting for the interior to dry out properly before applying the trim and decorative treatment. The concrete house may help to solve some of these difficulties in the opportunity it offers for skillful manipulation of the concrete itself, but in any event it is well adapted to receive any sort of interior finish, and to preserve that finish from deterioration through the stability of its structure.

Exterior Finish

The exterior treatment of the concrete house offers many possibilities, depending upon the "system" or type of wall construction. One's first thought is naturally of stucco, and this treatment will undoubtedly be prescribed for the very great majority of monolithic and block houses. Fortunately concrete is, so far as we know, the most suitable base on which to apply portland cement stucco, and the most satisfactory results are to be expected thereon, whether the stucco be of the spatter dash variety applied with a paddle, or whether it be of the exposed aggregate type requiring the greatest skill in application. I might say a great deal on this subject, but I should like to call attention to the fact that certain systems of wall construction which give a flat uniform exterior surface can be very economically and very attractively finished by a single wet dash without the use of the trowel. The cost of such a finish is only a fraction of that of the usual two coat or three coat work, and this fact ought to be some inducement toward producing more accurate surfaces in the structural wall. If the wall to which such a dash is applied is not too dense and the proper condition of suction is assured by an intelligent workman, this finish is likely to be as free from imperfection and as permanent as the most expensive stucco finish.

I am not at all sure that such a finish could not be successfully applied to a block or tile wall that was laid in a mortar of about the same degree of absorption as the unit. I believe this would be well worth trying on a small scale, and I hope that some of the block and tile manufacturers will be sufficiently interested to carry out some experiments along these lines.

It has been well established by numerous examples of group housing that houses of similar plans and similar structural design can be finished in such way as to give the appearance of being quite different houses. This is accomplished by the use of different types of roofs and porches, and by variations in the architectural and decorative treatment, for example in orientation, in finishes of brick veneer and different colored stuccos, in details of entrances, etc. This flexibility is of considerable importance in its bearing upon the individual house problem, permitting the desirable individuality of appearance in many houses from a limited number of good standardized designs.

Summary and Conclusions

In review, let us hold to a clear prospective of the concrete house in its relation to the better house program of the future. Granted that we need better houses, that is, houses more nearly vermin-and fireproof, costing less for maintenance and depreciating more slowly, we find that the concrete structure approaches closely to the ideal. Let us emphasize the *structure*, for herein lies the greatest value of the concrete. At the same time let us remember that the concrete house is as susceptible to architectural treatment and as capable of being made into a beautiful home as any other.

There are some obstacles to the rapid introduction of the concrete house, chief among which is the lack of experienced builders. This not only retards development, but tends to make the present cost excessive and the cost is also higher than it will be eventually when economical design has been worked out and established by investigations and tests. Some of the more important problems have been outlined, none of them more pressing than the development of a satisfactory light weight concrete floor. In the meantime the nearest approach to the all-concrete structure seems to be the concrete-walled house with rigid main bearing partitions and steel lumber floors.

What seems to me to insure the place of the concrete house in the building program of the future is the intrinsic soundness of an investment in this type of house, even in the face of somewhat higher first cost. This, plus the knowledge that the concrete house is highly fire-resistive and free from continually developing defects, should make certain its ultimate success.

I hope that the members of the American Concrete Institute, from their intimate knowledge of concrete, will take an active interest in the further development of the concrete house. The business of building houses may not attract the great majority of us, but the great majority of us have to live in houses of some sort, few of which are entirely satisfactory as to fire risk, or entirely free from the structural and other defects which I have mentioned. It develops one's powers of observation and deduction to analyze some of these defects, trace out their causes and determine how they could be avoided. In my opinion the best ultimate solution is the reinforced concrete shell built according to standardized plans, by methods which will be tried and improved through experience. But there are other types of concrete houses which may be equally satisfactory. It is a great economic problem, and *any* solution which leads to the construction of better dwelling houses at reduced costs will benefit all mankind.

Concrete Block Bungalow

The illustration shows a five-room concrete block bungalow erected in Bellingham, Wash., by G. W. Walker, building contractor. The blocks are made with enough lampblack in the facing material to give a slate color. The trim stone is in pure white. Plain block were used and some rock face in porch and foundation.

This dwelling, the first of a series that Mr. Walker intends to build, was sold for $5,000.

The windows were fitted into the structure by using joist blocks, which made a snug fit around the 3-in. projection from the frame, in which the weights travel. The joints are pointed with white cement. The interior is plastered over lath placed on furring strips.

New Contributions to Knowledge of Concrete

> This is but a partial digest of the proceedings of the American Concrete Institute Convention, in Cincinnati, January 22 to 25, inclusive. Other matter will appear in March CONCRETE. Much of the valuable material of the meeting does not lend itself readily to digesting. Its value is in the complete information. The full report makes a large volume. It will appear as *Vol. 19, Proceedings, American Concrete Institute.* To it acknowledgment is made for the matter here presented in advance of the issuance of the copyrighted *Proceedings.*—EDITOR.

In many respects the nineteenth annual convention of the American Concrete Institute was the best meeting the organization ever held. While a great deal of material was presented involving research test data and design matter, which is always best assimilated as published later in the complete *Proceedings,* the *discussable* contributions were notably on the increase. A convention, as a convention, irrespective of the value of the published proceedings, is after all of value in proportion to the number of interested participants who get down to brass tacks. A new products manufacturer member from New England said the convention was worth precisely $1,500.00 to him. Information which he was able to get at one of the products sesssions enabled him to save exactly that amount by reason of changes which he would make in proposed plans for handling his aggregates.

Then again, we discuss the requisites of good concrete up hill and down, and always find it hard to translate our discoveries to a workable rule of practice. There were many who put a high value on the four rules for good concrete, which F. R. McMillan said had guided his own practice. Here are the rules:

> Use as much stone as conditions will permit,
> Use as large stone as conditions will permit,
> Use as little water as conditions will permit,
> Keep the concrete moist as long as conditions will permit.

* * *

The convention developed a good deal of that practical kind of discussion—involving that kind of advice which is founded on laboratory investigation, but has been properly tempered by the changing conditions of the job.

There was a considerable increase in products manufacturer attendance, and as the two sessions provided did not give them time enough, they held supplemental sessions of their own and threshed out many problems in a way possible only in close-up round-table fashion, by men who have common problems and a broad understanding of the possibilities of organized cooperation.

The contracting problems, growing out of a sincere effort to control the quality of concrete on the job, developed at least two sessions very much worth while.

The Question Box for engineers and contractors was a pronounced success. It will have further attention in CONCRETE for March.

There was a decided sentiment in favor of a session next year which will be planned for and turned over to the job superintendents.

Thus is the Institute making definite progress in getting theoretical knowledge and the knowledge of job practice together on a basis of workable knowledge of better concrete.

In three years the Institute has grown in membership from about 400 to nearly 1,000—a membership far more nearly representative than at any other period in its history. Through the Institute the idea is taking hold that while the products manufacturer, the road builder, the building contractor, the designing engineer, the field engineer, the research man, have different viewpoints in special matters, the big problems are common problems which can only be solved by all these groups acting together.

* * *

Not only in practical matters was the convention a success: Lorado Taft, sculptor, Chicago, made a most inspiring address, setting forth the wonderful possibilities in concrete's application to the uses of art and beauty. His talk was based largely on the use of concrete in *The Fountain of Time* (described in CONCRETE for December, 1922), and he was followed on the program by John J. Earley, whose development of a technique in surface treated concrete made possible such a work as Mr. Taft described.

* * *

Officers were re-elected as follows: president, W. P. Anderson; vice-president, A. E. Lindau; secretary and treasurer, Harvey Whipple. The only new director is S. C. Hollister, Philadelphia.

* * *

At its next convention, 1924, the Institute will celebrate its twentieth anniversary, and plans a meeting of a character to make the event of special significance, the date tentatively fixed being Feb. 25-26-27-28.

The digests which follow touch only some of the high lights. Several of the Institute papers will have consideration more at length in succeeding issues of CONCRETE.

Block, Tile and Brick

Presentation by Committee P-1 of proposed standard specifications for Concrete Building Block and Concrete Building Tile and the Proposed Standard Specifications for Concrete Brick developed discussion of the lowest strength requirements. The proposed specifications of the committee provide four classes of units, with strength depending upon use. The specifications were accepted as tentative and will be published in the Institute *Proceedings,* thus being open to criticism and further study.

The tentative specifications for strength and absorption of block and tile are as follows:

Strength Requirements

3. According to the strength in compression 28 days after being manufactured, or when shipped, concrete block and concrete tile shall be classified as: A—heavy load bearing, B—medium load bearing, C—light load bearing, and D—non-load bearing on the basis of the following requirements:

	Compressive strength, lbs. per sq. in. of gross cross-sectional area as laid in the wall.	
Name of Classification	Average of 8 or more Units	Minimum for Individual Unit
A—Heavy load bearing block or tile.	1200	1000
B—Medium load bearing block or tile	700	600
C—Light load bearing block or tile..	500	400
D—Non-load bearing block or tile...	250	200

4. The gross cross-sectional area of a one-piece concrete block or tile shall be considered as the product of the length times the width of the unit as laid in the wall. No allowance shall be made for air spaces in hollow units. The gross cross-sectional area of each unit of a two-piece block or tile shall be considered the product of the length of the unit times one-half the thickness of the wall for which the two-piece block or tile is intended.

5. The compressive strength of the concrete in units of all classifications except class "D" shall be at least 1,000 lbs. per sq. in., when calculated on the minimum cross-sectional area in bearing.

Absorption Requirements

6. Concrete building block and tile to be exposed to soil or weather in the finished work (without stucco, plaster or other suitable protective covering) shall meet the requirements of the absorption test.

7. All concrete building block and tile not covered by paragraph 6 need not meet an absorption requirement.

8. Concrete block and tile shall not absorb more than 10 per cent of the dry weight of the unit when tested as hereinafter specified, except when it is made of concrete weighing less than 140 lbs. per cu. ft. For block or tile made with concrete weighing less than 140 lbs. per cu. ft., the absorption in per cent by weight shall not be more than 10 multiplied by 140 and divided by the unit weight in pounds per cubic foot of the concrete under consideration.

Corresponding requirements for concrete brick are:

Strength Requirements

3. The average compressive strength of concrete brick 28 days after being manufactured or when shipped shall not be less than 1,500 lbs. per sq. in. of gross cross-sectional area as laid in the wall, and the compressive strength of any individual brick shall not be less than 1,000 lbs. per sq. in. of cross-sectional area as laid in the wall.

4. The gross cross-sectional area of a brick shall be considered as the product of the length times the width of the unit as laid in the wall.

Absorption Requirements

5. Concrete brick shall not absorb more than 12% of the dry weight of the brick when tested as hereinafter specified except when they are made of concrete weighing less than 140 lbs. per cu. ft. For brick made of concrete weighing less than 140 lbs. per cu. ft., the average absorption in per cent by weight shall not be more than 10 multiplied by 140 and divided by the unit weight in lbs. per cu. ft. of the concrete under consideration.

Surface Treated Concrete

A paper on developments in surface treated concrete, presented by R. F. Havlik, vocational director, Mooseheart, Ill., and a demonstration by an assistant from the Mooseheart shop, will be extensively digested in the March number of CONCRETE. An actual demonstration was made of the method used in turning up a plaster model and also treating the surface of ornamental concrete in an acid bath, to remove the cement film and expose the aggregate. Methods for making and using a piece mold and master mold were also demonstrated.

Concrete Block Fire Tests

Committee P-5, Leslie H. Allen, chairman, submitted a progress report on the fire resistance of concrete building units. Standard 5-hour tests were carried out on three separate panels, at the Underwriters' Laboratories. Panel "A" was subjected to the fire hose stream test as soon as it was removed from the furnace, and Panel "G" was subjected to the impact test after cooling.

The panels appeared to be intact when taken from the furnace, with no apparent spalling of the surface in any case. It was found, however, in pulling down panel "A," constructed of silicious aggregate block, that the block were badly cracked through the face and web and that they had lost practically all of their strength. The block in panels "A" and "G" were found to be de-hydrated to a depth of between ¾ in. and 1¼ in., and testing for compression after they were removed indicated that they had lost about 35% of their strength. Subsequent tests, however, conducted six days after the block were removed from the panels, indicated a slight increase in strength of the blocks having limestone aggregate, and 10 days later showed the block had regained their former strength and in some cases tested better than the original block, before the fire test. It was found that the face of the block of limestone aggregate had been calcined into lime, which slaked on the application of water after removal.

The impact test conducted on panel "G" showed that the falling beam cut through four courses of block at the first blow, and through two additional courses at the second blow. The stability of the panel was not destroyed. It was apparent that the cracking in the panel was due to the impact, rather than to heat of the furnace.

The committee reported that while these test panels successfully prevented the passage of fire, it seemed fairly obvious that the 5-hour test is a more severe test than standard concrete block can be expected to gain a perfect rating on, and considering the fact that common clay brick work surrounding the panels was damaged even more than the block, it is doubtful whether any 8-in. wall of block or brick may be expected to stand this severe exposure. The committee recommended that the program be changed so that the fire test of the remaining panels would give information as to what heat and what duration of heat a concrete block structure can be expected to stand, rather than proceed with 5-hour tests, which the results from the first three tests indicate are too severe for any commercial building unit.

Design of Sewer Pipe

C. F. Buente, chairman of Committee P-7, announced that after long and careful study, the committee members were in practical agreement on reinforced concrete sewer pipe specifications, which will probably be presented next year.

Concrete Culvert Pipe

Committee J-2 reported tests having been continued to secure information covering loads on culverts in railroad and highway embankments and if possible to discover the laws of variation of such loads. Although these tests are not yet concluded, certain underlying principles have been found to be involved.

The ability of a culvert pipe to carry a load after it has been built into a culvert depends on construction conditions, as well as upon the strength of the pipe itself. The construction conditions referred to are:

1. Ditch conditions, those where the pipe are laid in a ditch in the same manner as used for sewer pipe.
2. Imperfect conditions, where the embankment extends to a total height greater than three times the depth of the ditch referred to under ditch conditions.
3. Projection conditions, where the pipe projects above the surrounding soil.

At the last meeting of the joint Culvert Pipe committee, it was decided to revise the pipe classifications referred to the report of Committee J-2 last February, the change being apparently advisable on account of certain misunderstandings of some engineers using these classifications. The revised tentative classifications specify 1600 *D* pounds per lineal foot of pipe where *D* is the nominal internal diameter of the pipe, using the three point bearing test as described in American Society for Testing Materials Standards, Serial C 14-20.

1300 D pounds per lineal foot of pipe. Pipe for this class must sustain a load of 1300 *D* pounds per lineal foot at the appearance of the first crack and the ultimate strength of the pipe must be at least 50% more.

1000 D pounds per lineal foot of pipe. Pipe for this class must sustain a load of 1000 *D* pounds per lineal foot at the appearance of the first crack and the ultimate strength of the pipe must be at least 50% more.

For the present, it is recommended by the committee that a given pipe specimen be judged by performance rather than by theoretical design.

Saving on the Mix

The method of obtaining a plastic mixture with a small amount of water by the proper grading of aggregate, as discussed by Professor Duff A. Abrams and practically demonstrated by Stanton A. Walker, at the 1922 convention, with particular reference to their importance in structural work, was this year discussed with a view to showing how these methods may be applied to concrete products manufacturing. The grading of aggregate and a regulation of the mixing water are cited as being important factors that enter into the manufacture of concrete products.

Numerous experiments have been conducted at the Structural Materials Research Laboratory and large expenditures have been made, aimed at producing better products for the same cost or the same products at less cost.

According to Stanton Walker, who gave an actual demonstration of the method of making a sieve analysis, a live organization of products manufacturers had a number of tests carried out at the Lewis Institute indicating that better products are aimed at. Vital factors in the control of finished products include quality, cleanliness, size and grading of aggregates, quantity of cement, age of the product, condition of curing, method of placing the material in the molds, type of machine used, etc. In regard to the time of mixing, tests were reported as showing no evidence of bad effect of mixing more than 5 or 6 minutes. Some tests have been made where mixing was continued up to 15 minutes. The increase in strength under ordinary conditions for the first two minutes of mixing is quite rapid, and later the increase with the longer mixing time is at a lesser rate.

Experience in carrying out the tests indicates that small percentages of fine material in the aggregate are not detrimental and that it is not important how much passes the 100 mesh sieve up to 10% of the aggregate.

How to Make More Money in Block Business

The report of Committee P-6 by John Lowell, chairman, stated that the committee had held a meeting and changed the division of costs, as presented in an Institute preprint of the committee report. The necessity for manufacturers keeping cost records so they can all be considered before fixing selling price of the product was emphasized.

The discussion by various products manufacturers present indicated that methods for cost keeping must depend somewhat upon local conditions and that cases are on record where credit was extended to the manufacturer, and credit rating increased, when bankers were shown actual costs kept by a systematic method.

At the round table discussion of products plant operating and cost problems, the importance of continuous plant operation was brought out, and the desirability of so arranging the plant that operations could be carried on the year round was emphasized, so that properly seasoned products would be available at all times to fill orders as received.

The question of marking and dating of blocks as contemplated by the building department of Indianapolis was discussed and considerable opposition raised on the ground that it was unfair to specify both methods and results. It was reported by a representative of the Indianapolis Building department that blocks made by 52 firms were tested in Purdue University. The tests were made because of cellar wall failures, which had previously occurred. Three of the products tested passed 800 lbs. per sq. in. and some ran as low as 250 lb. The trouble was attributed to improper curing, in some instances to too much sand, and in other cases to not enough water. It was apparent that the blocks went out of the plant in some cases when they were 5 days old.

The possibility of production being hampered by building code regulations was considered a very serious matter, but the experience in Indianapolis indicates that many of the manufacturers have their work cut out for them before they can complain.

New Design for Concrete Water Tanks

A paper prepared by W. S. Hewett, consulting engineer, Minneapolis, describing a new design he has worked out for concrete water tanks was presented by F. R. McMillan. Mr. Hewett's design involves the principle of a cylinder representing the top part of the tank, which is constructed with little or no reinforcement and afterwards bound with hoops similar to those used on concrete stave silos, which are placed outside of the concrete cylinder. The hoops are stressed to a given tension as indicated by strain gauges. In this manner, the concrete shell is put in compression and as soon as the tank is loaded, any stress in the concrete is neutralized and the additional stress is taken by the steel. After the tank is completed, and the hoops in place, a coat of gunite or an independent shell of concrete is placed outside of the hoops as a protection against corrosion.

Such a tank is now under construction at Barnum, Minn., which will have a capacity of 100,000 gal. with hoops having an initial stress of 15,000 lbs. per sq. in. After the tank is loaded 1,000 lbs. per sq. in. will be added to the stress making a total loading in the steel of 16,000 lbs. per sq. in.

Effects of Impure Water Upon the Strength of Concrete

The results of tests to determine the effect of impure water on the strength of concrete were discussed by Professor Duff A. Abrams, Structural Materials Research Laboratory, Lewis Institute, Chicago, and as in the case of alkali waters, the effects are classified under two headings; namely: of impurities in the mixing water, and in the water which comes in contact with the concrete externally. The tests indicate that the effects of impurities in the mixing water are not serious as are effects of impurities in the water which comes in continuous external contact with the concrete with a constant new supply of impurities.

Water samples with varying degrees of impurities were used in making the test specimens, varying from distilled water to tannery wastes and water containing sewage.

Practically the same results were obtained where distilled water was used as with ordinary water. Tannery waste reduced the strength of specimens to approximately 80% of normal. While the effect of certain impurities is noticeable, the increase in strength of concrete with age was found to be practically the same as in normal concrete. No essential variation in strength with lean or rich mixtures was noted.

Certain definite conclusions are apparent from the test results obtained. Acid water should not be used. Refuse of tanneries and oil refineries should not be used. Salt above 10% should be avoided.

In reference to the use of sea water as mixing water for concrete, the viaduct at Key West was cited as an example of very good concrete, where the reinforcing was left out and sea water used as mixing water. Bog waters, which looked bad, were found to affect strength only slightly when used as mixing water.

Specifications for One-Course Concrete Highway

The report submitted by W. M. Acheson, chairman of Committee S-6, was submitted only to stimulate discussion. The report will be printed in the Institute proceedings as a progress report, not as a tentative standard and will be open to discussion for one year, with a view to presenting, at the next convention, a standard specification for one-course concrete highway.

Feldspar Aggregate

"An interesting Case of a Dangerous Aggregate," a paper by J. C. Pearson, chief, Cement Section, U. S. Bureau of Standards and G. F. Loughlin, U. S. Geological Survey, deals with a very interesting subject which came up as the result of an article originally published in the magazine, CONCRETE, descriptive of the disintegration of concrete stone with feldspar aggregate. An abstract of this paper will be published in a later issue of this magazine.

Concrete Floors

Proposed standard specifications for concrete floors which have been under consideration for the last two years were presented by N. M. Loney, chairman Committee C-2, in a slightly revised and rearranged form and were voted upon to be printed in the proceedings as tentative. Features of the proposed standard were described in the March, 1921, issue of CONCRETE.

Fuel Oil Storage Tanks

A proposed standard specification for concrete fuel oil storage tanks was presented in preprint form by Committee S-4, G. A. Smith, chairman. It was adopted as a tentative standard, with the title "Tentative Recommended Practice and Tentative Specifications for Fuel Oil Tanks."

Specifications for Sewers

Proposed standard specifications for concrete sewers (monolithic) were presented by Committee S-4—Langdon Pearse, chairman—with notes on sewer design, and ordered printed as tentative for the period of one year.

Contractor's Plant

Committee C-1, of which J. G. Ahlers is chairman, presented a report on Contractor's Plant. The report was presented in abstract and only in part by the Committee at the Institute convention in 1922 and was finally omitted from the proceedings owing to incompletion of drawings. The report was presented in full at the 1923 meeting and the figures upon which the charts were based have been revised as of the Fall of 1922.

The report is divided into three parts: (1) a consideration of the factors that govern the choice of wheeling or chuting equipment as a means of placing concrete; (2) a re-study of the last published charts which were made when conditions in the labor and material market were abnormal and (3) a new set of charts similar to those published in the 1921 proceedings of the Institute, but based on the more normal conditions existing at the present time in the material and labor markets.

Surface Finish and Stucco

The report of Committee C-3 was made by J. C. Pearson, chairman, and the proposed specifications were adopted as tentative for the finish of exterior surfaces of concrete industrial buildings with explanatory notes. The substance of these proposed standard specifications was published in Concrete for June 1921.

Proposed revised standard recommended practice for portland cement stucco, was presented by J. C. Pearson, chairman of Committee C-3, and passed to letter ballot for adoption.

Concrete Houses

John A. Ferguson, chairman Committee S-5 on concrete houses reported that progress has been made by the committee and that further studies are to be made with a view to concrete house specifications at the next convention.

Minimizing Defects in Building Construction

In a rather liberal treatment of the subject, "Some Defects in Concrete Buildings, Their Causes and How to Minimize By Proper Design," H. D. Loring, of the Ferro-Concrete Construction Co., Cincinnati, also pointed out that many errors in design of concrete buildings are not those that lead to collapse or even to cracks. The loss of labor and material, due to wasteful designing or poor judgment in the selection of type of construction, loads and stresses, are pointed out as real though unseen losses not less than such defects as are considered structural defects. A digest of Mr. Loring's paper will be presented in a later issue of Concrete.

Inundation Methods for Measurement of Sand in Making Concrete

A paper by W. A. Slater and G. A. Smith, U. S. Bureau of Standards, on the inundation methods for measurement of sand, was presented by Mr. Slater and was followed by a discussion and practical demonstration of inundated sand methods of water control by R. L. Bertin.

The investigation reported was undertaken with a view to developing the principles of a proposed method of accurate field measurements of sand and of water for concrete. The method is based upon the belief that one of the important causes of variability in the strength of concrete is the variation in the quantity of sand and water entering into successive batches of concrete, even when care is exercised in the measurements. Sand, when measured by volume is in either a loose or a compacted condition and may show great variation in volume for a given weight, depending upon the quantity of moisture in the sand. In one case, this was found to be 49.7% greater than the volume of the same quantity of the same sand when dry. A concrete using that sand and designed to be mixed in the proportions 1:2:4 of dry materials would in reality, be mixed in the proportion 1:1-1/3:4, if the sand were measured in a moist condition, such as reported. If the same quantity of water is added per batch for the moist sand as for the dry sand, the increase in the ratio of water to cement due to the moisture content of the sand, will result in a decrease in the strength of approximately 15%. At the same time, the cost of the cement for a cu. yd. of concrete will be increased by about 15%.

Tests were carried out at the Bureau of Standards, a portion of the expense of the investigation being borne by the White Construction Co., of New York. The Bureau of Public Roads furnished the crushed limestone used.

In the sand measurement tests, the sands were used dry, moistened with 5% of water, and flooded with water. Under each of these conditions the quantity of sand which could be placed in a 0.1 cu. ft. measure in water was determined by placing it successively by the different methods devised. The amount of water in the container with the sand was also determined for all conditions.

In order to furnish a basis for comparison of the results with those obtained by measurement ordinarily used in making of concrete, the quantities of dry, moist and wet sand respectively which could be placed in the container without water were determined. Tests were made to determine the amount of water which could be carried by the course aggregate both as surface water and as absorbed water.

The strength of the concrete in which dry aggregates were used is in all cases greater than the strength of corresponding concrete in which the sand was measured in water and in which the coarse aggregate had been previously watered. Correspondingly the slopes and flows of the former concrete were less than the slopes and flows for the latter concretes. More water was added to the batches using the dry aggregate than to those using wet aggregate to make up for the surface water carried in by the wet coarse aggregate.

Some of the results of the investigation are summarized as follows:

"The results of the tests indicate that when sand is measured in water the quantity of sand per unit of volume is almost constant regardless of the original water content of the sand and that the water filling the voids in the sand is also nearly constant for any given method of placing the sand.

"The shoveling of the sand into the water gave more nearly constant quantities of sand and of water per unit of volume than any of the other methods used.

"The inundation method of measurement when used with a pre-determined apparent specific gravity may afford a convenient means of determining the proportion of sand to other concrete materials even for jobs on which the materials are being measured by other than the inundation method.

"The variation in surface water per cu. ft. of coarse aggregate was approximately proportional to the variation in the fineness modulus of the coarse aggregate. The quantity of surface water was considerably greater for the crushed trap rock than for the quartz pebbles. The quantity of surface water averaged about 9% of the total water used in the concretes of these tests or about 8% by volume of the cement. The quantity of absorbed water per cu. ft. was greater for the quartz pebbles than for the crushed trap and was independent of the fineness modulus.

"For concretes made with quartz sand measured in water the strengths were nearly the same regardless of the condition of the sand, the method of placing it, and the proportion of fine aggregate to coarse aggregate.

"The indication is that the measurement of sand by inundation methods should be of assistance in reducing variability of strength of concrete caused by variations in quantities of sand and water in a batch.

"The use of a constant water cement ratio for the concrete together with a constant fineness modulus for the mixed aggregates resulted in nearly a constant strength regardless of the proportion of fine to coarse aggregate in the mix.

"The use of a constant fineness modulus of the mixed ag-aggregate resulted in nearly a constant strength regardless of concrete. The variation in each was approximately proportional to the variation in the fineness modulus of the fine aggregate in the mix.

"The weight of the concrete per cu. ft. and the volume yield of concrete per barrel of cement were practically constant."

Effects of Serious Form Work Fire on Large Warehouse Job

The effects of a serious form work fire on the McDougall Terminal Warehouse, Duluth, considered a test of winter concrete, were described in a paper by A. R. Lord, Chicago, which will be dealt with more fully in a later issue of Concrete.

In the discussion following Mr. Lord's paper the possible injurious effect of too many salamanders was suggested, cases having been observed where heat from the salamanders caused the concrete to dry out too fast on the shell, thereby injuring the outer shell of concrete.

The proposed use of gypsum plaster with a gypsum binder for repairing spalled concrete surfaces was supported by Professor Abrams, who stated that tests have shown a strong bond between gypsum and concrete.

Variables in Concrete From the Construction Standpoint

A paper by Walter P. Bloecher of Stone and Webster Corp. contains considerable information as to the variables in concrete from the construction standpoint, submitted not with the idea that it can be used scientifically in any definite quantitative way, but rather as a reminder of the complexity of the subject from the job standpoint with some suggestions of points to be watched by the construction man who is troubled with erratic test results.

Twenty-seven factors are listed together with the range of their individual influence on the strength of typical 1:2:4 building concrete, between the best and the worst conditions that may be encountered in practice. The physical conditions producing the high and low strength are given in each case. Among the variables mentioned are variations as between brands of cement; fineness of cement; impurities in the aggregate; fineness modulus of mixed aggregates; quantity and temperature of mixing water; length of mixing time; curing conditions. In attempting to evaluate or reduce the various factors to a common basis, it is only possible to express them in terms of the percentage effect they have on an approximate 1:2:4 mix.

The data bring out several things of interest for the construction man, showing, for example, that there are three factors which may be of greater influence than the water-cement ratio under particularly poor conditions, viz, the cement variation, the organic content of the sand and the method of curing. The data also indicate the danger from such factors as storing cement, from mica in the sand, and from curing at low temperatures. In addition to the twenty-seven factors listed, it is stated that numerous other factors should be mentioned which have an influence on the strength of the final product on which the research data are either meagre, or which are scarcely susceptible to analysis. These items are classed under the headings sand, coarse aggregate, water, mixing, placing, curing, and miscellaneous.

The fact that there is a serious question in many minds as to the propriety of the 28-day cylinders as a true measure of concrete strength is pointed out. It is undoubtedly true that in many cases a large appreciation in strength takes place after the 28 days have elapsed; and yet it is cited that a better substitute has not been found. The suggestion is frequently offered that cores cut from the actual structures are a more representative measure. As to the comparative uniformity of cores against cylinders, it is evident that the cores show a striking improvement in this respect. But the results do indicate that the concrete, weakest at 28 days, gains most in strength with age, its handicap at 28 days being largely overcome.

In conclusion, it is stated that the present rule of thumb methods of manufacturing concrete are susceptible of much improvement and that we will see more uniform concrete in the future. The large number of factors involved, many of them beyond job control, should suggest a deliberate advance and give pause to the tendency to expect too radical an improvement in one jump.

Fountain of Time

Lorado Taft, Chicago sculptor, described in a very interesting way the events which led to the use of reinforced concrete in the structure of the *Fountain of Time*, after his original creation of it in plaster. A description of this triumph in application of concrete to uses of art was published in the December, 1922, issue of CONCRETE.

John J. Earley, architectural sculptor, Washington, D. C., by whom the *Fountain of Time* was done in concrete, described in detail the methods used. The advantage and economy of concrete for such work were found to be in the plastic placing of the material. With the aid of a plaster piece mold constructed on the original plaster group, the forms of the finished figures were obtained with fidelity, and without any of those deviations which are anticipated when the idea is to be carved from natural stone.

A mold was constructed around the entire model and the group of figures in the main part of the *Fountain of Time* divided into 26 sections. A plaster of paris mold was made up of approximately 4,500 pieces, the smallest of which was about 12 in. across, weighing 25 lbs., and the largest weighing approximately 1,000 lbs.

The results obtained in the construction of the *Fountain of Time* confirm Mr. Earley's belief that concrete is really, when properly developed, the most suitable architectural material.

Waterproofing

Committee E-7 on water-proofing, reported that it has for its present work the collection of a mass of data relating to the comprehensive outline of the field. Some of the work will probably be sufficiently advanced to present well considered specifications at the next annual convention.

The committee will take up the subject of water-proofing from the standpoint of performance of material, as determined by tests; will consider the method of application of the material to the structure, to be presented in the form of a specification; will consider the water-proofing details exclusive of structural design and present them in the form of a recommended practice; will formulate recommended practice for producing water-tight concrete without the use of integral compounds, membranous or surface treatments; and will consider recommended general principles which might control types of water-proofings to be applied to particular jobs of construction, these to be presented in the form of recommended practice.

Field Tests of Methods Used for Predetermined Strength

The report of J. G. Ahlers, Barney-Ahlers Construction Co., on field tests of methods used in New York building construction for obtaining concrete of specified strength, was accompanied by curves showing fineness modulus of samples of premixed aggregate, taken on the barge 1 ft. under the surface of the barge load, and also as the aggregate was being chuted into the mixer. It showed the relation between the grading of aggregate and the strength of concrete where a material was guaranteed to have a certain fineness modulus—the premixed aggregate now common in New York. Samples were taken representing the extreme cases, and an attempt was made to carry out in the field the conditions and results obtained in the laboratory.

The results obtained indicated that any tendency for segregation of the aggregate during transportation on the barges on which the aggregate was handled, was negligible, as indicated by the determination of the fineness modulus of samples as the aggregate was being chuted into the mixer.

The variation of 120% in the different brands of cement was cited by M. M. Upson as making it necessary to use twice as much of one brand of cement as of another to produce concrete of equal strength. This necessity for more uniformity of cement, if concrete is to develop uniform strength, is being met by the portland cement manufacturers, who are making a study of the actual constituents and properties of portland cement which will lead to eliminating erratic results in concrete.

Destructive Agents and Protective Treatments

The report of Committee E-6 by M. M. Upson, chairman of the committee, was presented in preprint form and the progress of the committee discussed. In approaching the study of the use of concrete in both fresh and sea water, the committee desired to ascertain as near as possible the experience and practice of engineers who had had the greatest opportunity to give thought to this particular phase of concrete construction. A careful review of the bibliography was made and in addition a questionnaire was sent out to about 75 of the leading engineers who, in the committee's opinion, were most likely to have data on the subject in question. Of the 51 replies received to the questionnaire, all but one gave approval to the use of concrete in fresh or sea water, and they were universal in stating that their general experience led them to believe that the failures of concrete in sea water service were attributable either to improper materials or poor workmanship.

The most emphasized essential of concrete for this service is impermeability. This and the best practices in selecting, proportioning, mixing, pouring, curing, and protection of the exterior skin of concrete must all be considered.

The exact chemical actions which occur when concrete is exposed to sea water are as yet only conjectures on the part of the engineer. It is quite generally believed that it is the action of the sulfate of magnesia of the sea water with the lime in the cement, and the alumina of the aluminate of the cement resulting in the formation of hydrated magnesia and calcium sulfo-aluminate, which crystalizes with a large number of molecules of water, and that both sodium chloride and magnesium chloride rapidly attack the silicates. It was for a time believed by chemists that the magnesia in the cement was in some way responsible for the deterioration. Others, however, are of the opinion that magnesia in normal amounts permitted in portland cement is probably inert and does not cause the cement to expand and crack. After the character of the cement has been changed by the formation of the sulfate aluminate of lime, the sodium chloride in the water is able to dissolve the calcium silicate in the cement. The calcium set at liberty is dissolved little by little in the water, which penetrates the mortar and gradually reduces the concrete. The softening of concrete seems to take place only when there is an abnormal amount of sulfuric acid present.

Sea water has no apparent action on the iron oxide of cement. For that reason, it would seem that a cement high in iron is desirable. All of the alumina, however, cannot be replaced by iron as a product resulting from the burning of ferric oxide, and calcium carbonate does not possess hydraulic properties.

The subject in question is considered under the following headings:

(1) Impermeability and density.
(2) Proportioning and mix.
(3) Quantity of water.
(4) Forms, spading and tamping.
(5) Curing.
(6) Proper location and percentage of steel.
(7) Avoidance of seepage or drainage action, especially during the period of setting.
(8) Avoid placing the concrete where it is subject to the alternate action of air and water during the period of setting.
(9) Exterior protection of concrete.
(10) Cement.

The outstanding lessons from the tests carried on at the Charleston Navy Yard, where specimens had been exposed for more than 13 years, are:

1. Aim for impermeability rather than density.
2. Use a rich mix.
3. Use a sufficient amount of water.
4. Avoid admixtures of other material with the cement.

ALKALIES

The rules pertaining to the selection of materials, grading, richness of mix, curing, protection of steel, drainage, forms, etc., are equally applicable to the production of concrete to stand the action of alkali. In order to insure the very best results and obtain an impermeable concrete, care must be exercised in selecting materials having proper grading and to make a mixture containing enough cement to not only provide sufficient strength, but to make an impermeable concrete which will withstand the action of both disintegrating agents to which it may be exposed. Provision for adequate drainage is an important factor. The possibility of water percolating through retaining walls or similar structures must be eliminated.

ACTION OF OILS, HIGH TEMPERATURES AND ACIDS

The most important consideration with reference to floors and walls of buildings used by the oil industry is to use a fairly wet and well worked concrete, with a 1:2:4 mix, using portland cement, clean river sand, and a coarse aggregate of gravel or crushed stone, not exceeding 1½ in. maximum size—the concrete smoothly finished. Oil will have little effect upon this concrete.

Where concrete core walls are used in settings for boilers and similar apparatus, various methods for protection for the concrete are employed, depending somewhat upon the temperature to be resisted. The protection may be a layer of common brick, and firebrick, or for higher temperatures, insulating brick or asbestos insulation may be used next to the concrete.

Sulfuric, phosphoric, nitric, hydrochloric or muriatic acids, when they come in contact with concrete, exert a considerable deteriorating effect. No data have been secured in this investigation relative to the action of other acids. As a protection against the acid action, a coat of pitch or heavy asphaltum applied on the surface of the concrete is of great value where there is no possibility of mechanical wear breaking this coating and permitting the acids to penetrate the concrete. Where there is mechanical wear, a layer of acid brick set in an acid-proof bed, should be used.

Trend of Design and Construction of Concrete Roads

A paper by H. Eltinge Breed, consulting engineer, New York City, discussing the trend of design and construction of concrete roads, as the effort to oust the trial and error method by establishing scientific procedure based upon ascertained facts, will be abstracted further in a later issue of this magazine.

Measurement of, and Estimating, Concrete

At the special group meeting held while the products session continued, a paper was presented by Frank R. Walker, Chicago, on estimating and cost keeping. Mr. Walker's paper will be digested rather extensively in a later issue of CONCRETE.

METHODS OF MEASUREMENTS

"Methods of Measurement" was the subject of a paper by J. W. Ginder, office of supervising architect, Washington, D. C., from which the following is abstracted:

Methods of measurement of the cost of concrete work may be considered as divided into three heads: methods of measurement of concrete work; methods of recording concrete work; methods of estimating concrete work.

There should be no differentiation between the rules of measurement to be used in determining the cost of production and as a basis of purchase of the finished product. Another heading might be added, "Methods of measurement for paying for concrete."

There is considerable difference between measurement of the price fixed representing the cost of executing the work, and the measurements that would be employed as a basis for unit price contracts. It is first necessary for the bidder to determine what the actual costs of the work will be, to which will be added his overhead and profit, and this price translated into a price per unit upon which to base a contract.

There should first be laid down definite standard rules of measurements for taking off quantities. Measurements that will permit the determining of the quantities of the several kinds of materials must be made, as well as the cost of all the separate acts of labor, such as the amount of cement, sand and aggregate, mixing the concrete, carrying it to the place it is to be used, placing and tamping it, etc.; the cost of cutting, bending, placing and securing the reinforcement; the cost materials for the forms; the making, placing, stripping, remaking, resetting, together with the depreciation and salvage value.

A uniform cost keeping system is necessary before dependable estimates can be made for submission in competitive bidding. Standard rules should be adopted requiring that measurements be made in a manner so as to permit the determining of the quantity of all the materials and the amount of labor necessary for the proper execution of each kind of work. This would require that concrete of different kinds and in different positions be taken off separately. It costs more to get the concrete or the materials to the top of a 20-story building than to the first floor, or to place concrete in a reinforced floor than in a heavy wall. The amount of labor required to place reinforcing steel is more in some places than in others.

In deducting voids and openings, if there is extra cost in connection with forms in the finishing of the concrete on account of the voids or openings, such extra labor should be taken off and fully described. If the corners of beams or columns are chamfered, this fact should be noted in connection with the quantity of materials and labor for the forms. A complete bill of quantity of all lumber required for forms should be made, that for forms of a different character being kept separately.

Assuming that standard rules of measurement for unit price contracts should be made, it is believed that they could be reduced in number.

For mass concrete, such as walls, or even reinforced floors, the unit of measurement for the basis of a contract should provide for the concrete by the cu. ft., for the steel by weight, and for the forms by the square foot of the surface of concrete in contact with the forms. The unit of measurement for work on columns, cornice, moldings, cast trim, and similar work, might be by the piece or the linear foot for the finished product. The unit size could be determined from drawings which definitely fix the design and dimensions.

The Lincoln Highway Ideal Section

Modern methods employed in the construction of concrete roads—unloading and filling, transportation, grading, mixing, and finishing—were illustrated by motion pictures furnished by the Koehring Co. and described in an accompanying talk by G. A. Sherron.

A paper on design and construction features of the ideal section of the Lincoln Highway, and why, prepared by W. G. Thompson, consulting engineer, St. Petersburg, Fla., was read by C. R. Ege. Widespread popular demand for highway construction in 1920 convinced the officers of the Lincoln Highway Association, a non-profit corporation organized for the purpose of marking the shortest and best line for a transcontinental highway from the Atlantic to the Pacific seaboard, that the necessity for further urging of the building of highways had passed, and gave rise to the idea of constructing a section which should, as nearly as possible, embody those features considered ideal from the viewpoint of the user and owner. As a result of 4,600 questionnaires mailed to highway engineers in public employ, professors of engineering and others, requesting suggestions, the committee selected portland cement concrete of 1:2:3 mixture, laid in one course for the pavement.

The ideal pavement was considered as that one which embodies uniform smoothness, least resistance to tractive effort, durability, absence of skidding properties, and comparatively low first cost and maintenance. The committee decided these qualities were more pronounced in the concrete than in several of the other excellent types in common use. Concrete has the advantage that it is at once foundation and surfacing. It has been demonstrated successfully that, after many years of wear, concrete pavements will serve as a foundation, either for additional concrete surfacing, or other types.

The specifications covering width of pavement were predicated upon an average traffic of 15,000 passenger automobiles per 24-hour day, traveling at a speed of 35 miles per hour, and 5,000 motor trucks per 24-hour day, traveling at an average speed of 10 miles per hour. It was decided that the ideal section should have a width for four lanes of traffic, leaving to future police regulations the task of enabling full use of the 40 ft. pavement by compelling vehicles to occupy their proper lanes during congested periods.

In the slab design, specifications called for a limiting superimposed load of 800 lbs. per in. of width of tire actually in contact with the road surface, and 8,000 lbs. per rear wheel. Assuming the total rear axle load at 16,000 lbs. as 75% of the total gross load, then the total permissible load per truck would be 21,333 lbs.

The adoption of a slab 10 in. uniform thickness on a crowned sub-grade was influenced by tests conducted by the Bureau of Public Roads. These tests showed that, as representing the average relation of thickness to impact resistance, the 10-in. slab of 1:1½:3 concrete on a good foundation will resist single wheel impact of 44,000 lbs., at least until permanent sub-foundation deformation occurs.

The committee believed that in the absence of definite knowledge, the factor of safety with the slab selected was ample, since it was further increased by addition of 80 lbs. of reinforcing steel per 100 sq. ft. and introduction of steel dowels through transverse and longitudinal joints. The steel reinforcing was placed not because it bore a definite relation to the stresses developed in the slab, but to assist in holding together the several sections should cracks occur. Eight steel dowels ¾ in. by 5 ft. were placed across the transverse joints, two along the outer edges and two on each side of the longitudinal joint, to assist in carrying loads at the slab corners.

Premolded transverse expansion joints were placed at 75-ft. intervals. A longitudinal joint was placed at the center of the 40-ft. slab.

The aggregate was graded glacial gravel, all of which passed a 2-in. screen, for coarse aggregate, with sand having usual standard specifications.

Design of Elastic Structures From Paper Models

A paper was presented by Professor George E. Beggs, Princeton University, supplementary to his paper at the 1922 convention on the subject, "An Accurate Solution of Statically Indeterminate Structures by Use of Paper Models and Special Gauges." The 1922 paper won for its author the Wason medal for the most meritorious paper of the year. In the new paper additional evidence of the correctness of the results obtained from the deflections of paper models was first presented, and second, some of the practical uses of the model method of analysis were indicated. The celluloid structures used in demonstrating were designed from the results obtained from smaller paper models. By use of the measuring microscope and special gauges, the reactions of these structures were completely determined for various conditions of loading.

A reaction is completely defined when its magnitude, its angular direction and a point through which it acts, are known. If the reaction is taken by a hinge, the point of action is through the hinge, and only the direction and magnitude of the force must be determined. If any reaction of any elastic structure is correct in position, direction, and amount, such single reaction applied at the support of the structure will produce both static and elastic equilibrium.

The solution of various problems was illustrated involving a two-hinged arch; a two-hinged frame; a circular ring, representing a section of pipe; a four-post continuous portal with columns fixed at bases; an arch with fixed ends; a multiple arch with elastic columns.

A comparison of designs of continuous beams illustrates the use of an elastic model and the advantage that may be gained by employing a beam of variable sections.

To save time in reading the deflections of many points of a paper model under test, resort has recently been made to photography and the use of double exposure on a photographic plate. A black paper model is used with white center lines, or other measurable reference marks. It is thus possible to record on the photographic plate the deflections of all points of the model caused by a motion of the support, and these deflections divided by the deflection of the support are influence values for the reaction. This process of recording displacements on a photographic plate has long been used in astronomical work.

Correction Data for Comparative Test Results From Field Specimens

The need for eliminating as many as possible of the variables which exist between the two methods of procedure in order that the laboratory may obtain the best results from field data, first with reference to test specimen, either made from the freshly mixed concrete in the field, or from the mass after it has hardened, and second, with reference to the standard test specimen made under laboratory conditions, was discussed in a paper by G. W. Hutchinson, assistant engineer, North Carolina State Highway Commission. The data presented is applied principally to the correction necessary in the use of the core drill in highway construction.

The investigation was based upon the assumption that comparisons of field strengths would be made with the standard 6-in. by 12-in. cylinder as recommended by the American Society for Testing Materials, and that the ratio of height to diameter would not be less than one-half or greater than two. The range of tests, however, included specimens slightly exceeding the latter ratio.

A correction curve was drawn representing the total of about two hundred and fifty cylinders having a constant diameter of 6 in. and a height varying from 3 in. to 13 in., in steps of 1 in.

Curves were prepared for use as a means to secure a direct multiplication factor for use in making a correction of field strengths with reference to the standard laboratory 6-in. by 12-in. cylinders. When the field specimen is 6½ in. in diameter, as in the case where the specimen is taken by one of the core drills commonly used in pavement testing, the maximum deviation, from the correction curve, is 6% and the average deviation 1%.

It is evident from the investigation that the correction factor decreases as the height of the specimen increases. The effect on the compressive strength of the varying sizes of cylinder when the ratio of height to diameter exceeded 1, was considerably less than when it was less than 1. In highway work the usual thicknesses of pavement vary from 4 in to 8 in., and for comparative purposes, the concrete in a 4-in. specimen having a 6-in. diameter, would show a compressive strength over 50% greater than the same concrete in an 8-in. core of the same diameter.

The conclusions drawn from the results of this investigation are:

1. It is indicated that the use of a correction factor is necessary for the comparison of the compressive strength of concrete when the ratio of height to diameter of the specimen is varied.
2. A means of making the correction is furnished which is within the practical limits of testing, and applicable to the testing of concrete pavement construction or other field testing when the specimen is cylindrical and the ratio of height to diameter not less than one-half or more than two.

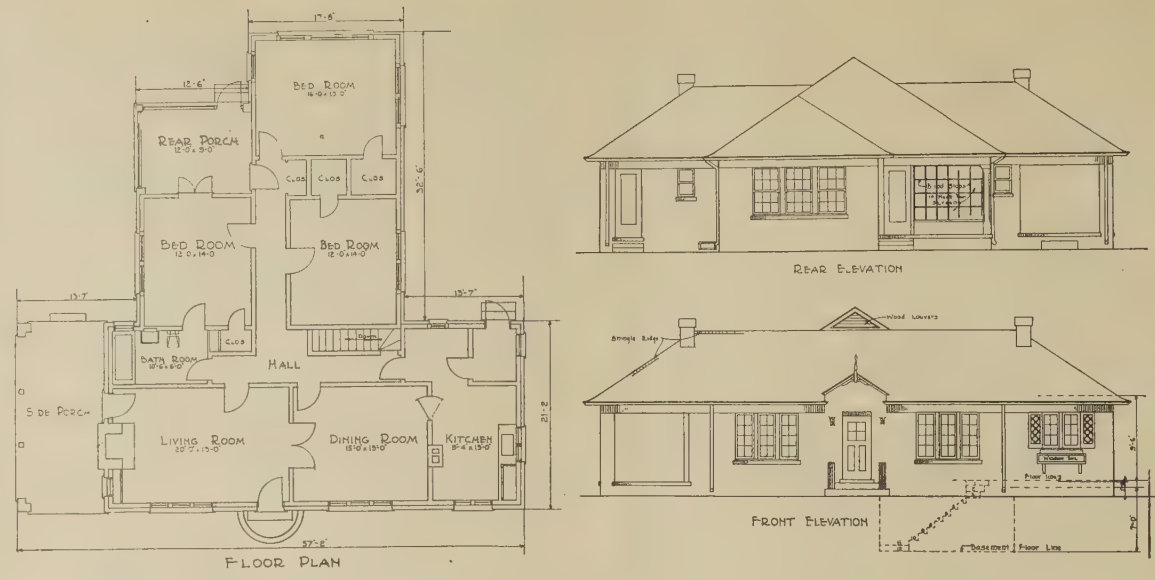


FIG. 1—PLAN AND ELEVATIONS OF CHARLES A. CLARK HOUSE

Concrete Brick House With Unusual Foundation

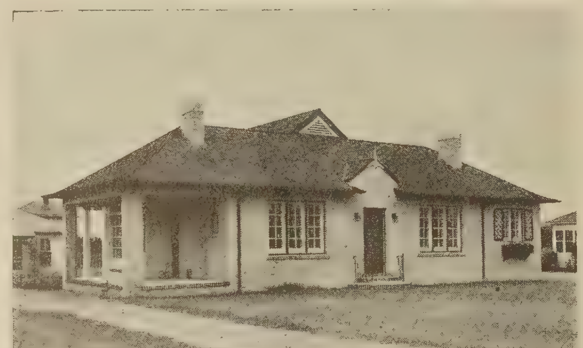


FIG. 2—HOME OF CHARLES A. CLARK, DALLAS, TEXAS

This attractive bungalow has an exterior of concrete face brick. It was recently completed for Charles A. Clark, district manager of the Portland Cement Association, Dallas, Texas.

"Any other kind of house than concrete should certainly be at least second choice for every concrete man," is the way Mr. Clark expresses it when enthusing over the many desirable characteristics of concrete house construction.

The building is a bungalow of ingenious and somewhat unusual floor plan. Robertson and Griesenbeck, Dallas, were the architects and The Christy-Dolph Construction Co. general contractors.

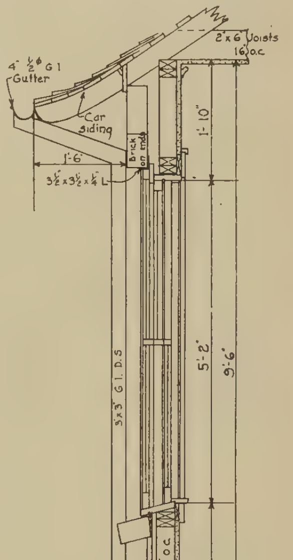
Perhaps the most unusual feature of the work is in the way additional support was secured for the foundations. The soil in that locality is a black waxy adobe with a record for a great deal of movement, likely to cause wall cracks. The people of the neighborhood very generally believed that it would be found impractical to construct a concrete house on the site selected, for that reason. On warm days cracks in the front yard have appeared 3 in. wide and several feet deep; after fall rains the soil swells like a wet sponge. Twelve-inch auger holes were carried down to solid rock and filled with concrete, these being placed at close intervals under the center line of the foundations. An 8-in. reinforced concrete wall was carried from a 7-ft. depth to grade line, giving a deep, and watertight basement. On account of the soil conditions people in that section have refrained from attempts to build basements.

Walls above grade are of brick veneer construction. Concrete face brick used throughout were made by the Texas Shope Brick Co., Dallas. The brick have good surface texture and are in variegated grays, being faced with a mixture of gray and white cement, to which a small quantity of mica was added.

The attractiveness of the building is enhanced by the modest use of wrought iron balustrades and lanterns, latticed window shutters and flower boxes.

Mr. Clark's residence stands on a plat 115 ft. by 201 ft. deep, and cost, exclusive of cement, $8,200. The cement was furnished separately by the owner.

It is believed that Mr. Clark's house will be an encouragement to home owners to build more substantially than many have done heretofore.



GENERAL WALL SECTION

The Road Show

The Fourteenth National Good Roads Show, held in connection with the Twentieth Annual Convention of the American Road Builders' Association, was a big success from the standpoint of record-breaking crowds and exhibits.

Crammed full and bulging at every inch with machinery and equipment, the old Chicago Coliseum sheltered this show January 15-19. It was the finest and best managed road show ever undertaken.

The exhibits were so big and numerous, the overflow filled the Annex, Ball Room, Greer and Wilson buildings, and then for blocks in either direction in Wabash avenue.

The attendance is estimated in the tens-of-thousands. One exhibitor alone registered over ten thousand contractors. He was giving away a concrete mixer to the lucky holder of a ticket. This opportunity was open to contractors only.

The massiveness of the machinery exhibited was impressive, while the towering effect gave one an idea the manufacturers were building higher and higher into the sky, but this was an illusion, for to economize in space the exhibitors raised the booms of their derricks and shovels skyward. One visitor remarked that the machinery "was getting too large."

The composite opinion of the show from the exhibitors' standpoint was "Fine show—splendid attendance," while from the contractors, engineers and commissioners it was "The best show ever." A machinery shopper could purchase anything from a hand shovel to a 32-E mixer, and take his pick at that. There was a big variety of everything the road builder needs.

The outstanding fact of the show was the amount of machinery and equipment offered to get the material to the road or to the mixer, if it be a concrete road, and the simple and efficient mixers that mix and place the concrete on the roadbed.

Another noteworthy feature, more pronounced at this show than before, was the exhibition of concrete road reinforcement. There were five exhibits of this nature, each showing reinforcement methods.

No phase of the great road building business was neglected. There were a number of new machines, such as mixers, portable conveyors, storage bin systems, tractors and finishing machines, and many new improvements on the older types, besides new motor trucks and dump wagons.

New equipment offered included:

Finishing machines: A. W. French & Co., 208 N. Clinton St., Chicago.; The Heltzel Steel Form & Iron Co., Warren, O.

Mixers: Orr & Sembower, Inc., Reading, Pa.

Hoist: Orr & Sembower, Inc., Reading, Pa.

Batch Hoppers: C. S. Johnson Co., Champaign, Ill.; Butler Equipment Co., Milwaukee, Wis.

Dump Body and Hand Hoist: The Heil Co., Milwaukee, Wis.

One encouraging feature of the show and of vital interest to the exhibitors, was the large attendance of manufacturers' agents and dealers. These men came from the four corners of the country to see what was new in the machinery and equipment markets. The fact that many carloads of machinery were ordered indicates to the observer that they expect to do big business in 1923. They ought to know, since they are in touch with every man in their respective territories.

There was one spot in the whole show where the studious visitors gathered when out of the convention's session. This was in the north gallery, where the various state highway departments had their plans, specifications, lantern slides, models, chemistry departments, testing machinery and samples of rocks and other materials and exhibits of methods of construction.

Back-Plastered Stucco Costs

Cost data on back-plastered metal lath and stucco construction from numerous sources, as compiled by the Associated Metal Lath Manufacturers, is as follows:

(1)	Back-plastered metal lath stucco construction	$2.17 per sq. yd.
(2)	Metal lath over sheathing	2.46 per sq. yd.
(3)	Clapboard sided house painted	3.23 per sq. yd.

(These items include studding, but not profit or overhead expense.)

Normally the only difference in cost between the back-plastered type and the sheathed type in which metal lath is used, should lie in a comparison between the cost of the sheathing and the labor to apply it as contrasted with the cost of the back-plastered coat, all the other elements which go into the construction of such types being practically identical as far as the material and labor costs are concerned.

Comparing the stucco house with the clapboard sided house, we find that while the cost for materials and labor on the stucco and metal lath items are closely offset by corresponding costs for materials and labor on the sheathing and clapboards, there is no cost entering into the construction of the stucco house to offset the unusually large item for painting the clapboard house. This cost is estimated at approximately 75c a sq. yd.

To bring out clearly the large differential in favor of the stucco house, we will use an ordinary two-story single family dwelling, with a ground area of 20 by 30 ft. and containing approximately 200 sq. yds. of wall surface.

We find that there is a saving of $200 for the metal lath sheathed stucco house as compared with the clapboard house. Besides, the clapboard house will cost $150 extra every third year for painting.

A back-plastered metal lath stucco house shows a saving of $65 over the sheathed metal lath stucco type, and over $265 less than the clapboard sided house. (These last figures on comparative costs include contractor's profit.)

A recent five-room house in Evansville, Indiana, was bid as follows:

If of 8 in. "Ideal" (brick or hollow wall)	$7,100
Frame (siding and painting)	6,930
Back-plastered on metal lath	6,533

In Milwaukee recent figures ran:

Colonial siding, sheathing (paint not included), per sq. yd	$1.64
Back-plastered cement stucco and lath	1.57

(Both erected.)

In California:

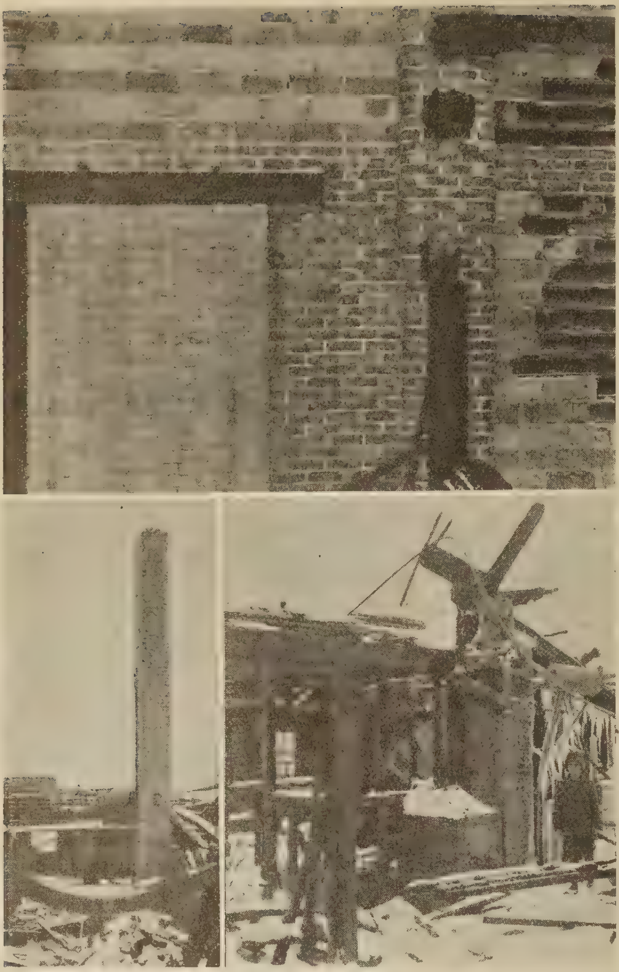
Stucco on metal lath and sheathing, per yd	$1.75
Back-plastered on metal lath, per yd	1.57

(Both erected.)

The following are the total average costs per yard of back-plastered stucco on metal lath in Evansville, Indiana, as of January, 1922:

Portland cement—25 bags, at 70c per bag	$17.50
Hydrated lime—6 bags, at 60c per bag	3.60
Sand—3 yds., at $2.20 per yd	6.60
24 ga. Herringbone Armco Iron Lath—100 yds., at 37c per yd.	37.00
Labor applying lath—100 yds., at 15c per yd	15.00
Staples for same—100 yds., at $1.50 per 100 yds	1.50
Hair for first coat—3 bu., at 60c per bu	1.80
Atlas White Cement—8 bags, at $1.00 per bag	8.00
Labor applying stucco—100 yds., at 84c per yd	84.00
GF No. 10 paste in last coat—6.66 lbs. at 15c per lb	1.20
Making a total of	$176.20

Adding 20% profit makes total $210.00, or $2.10 per yd.



Cinder Concrete Brick, Clay Brick and Hollow Clay Tile Were All Used Within a Small Area in a Wall of the A. Teachout Co. Plant, Buffalo, Destroyed by Fire December 30, 1922

Concrete Brick Withstands Severe Fire

The accompanying pictures show results of a fire in the woodworking plant of the A. Teachout Co., Leslie Street, Buffalo, N. Y., December 30, 1922.

Standard hard-burned clay brick, 5 in. by 8 in. by 12 in. hollow clay back-up tile and cinder concrete brick made by the Burnett-Wilson-Pfhol Co. (Bo-process) were all subjected to very intense heat. The clay brick were badly cracked and in projecting pilasters the corners spalled. The cinder concrete brick alongside are still hard and sound. What happened to the clay tile walls immediately adjoining the brick panels is clearly shown, the entire face of the tile exposed to the fire spalling off over considerable areas and destroying one-third of the load carrying capacity of the tile immediately.

The wall shown was originally built of clay brick, and the large door opening at the left subsequently closed up with a wall of cinder brick. All three types of construction are believed to have been exposed equally to the fury of the fire. The cinder brick chimney, shown in another picture alone marks the location of one building, which was largely of frame construction.

The cinder brick in this chimney are still sound, while a few feet away a clay chimney, because of the poorer bond between the brick and the mortar, is practically destroyed. See Fig. 3.

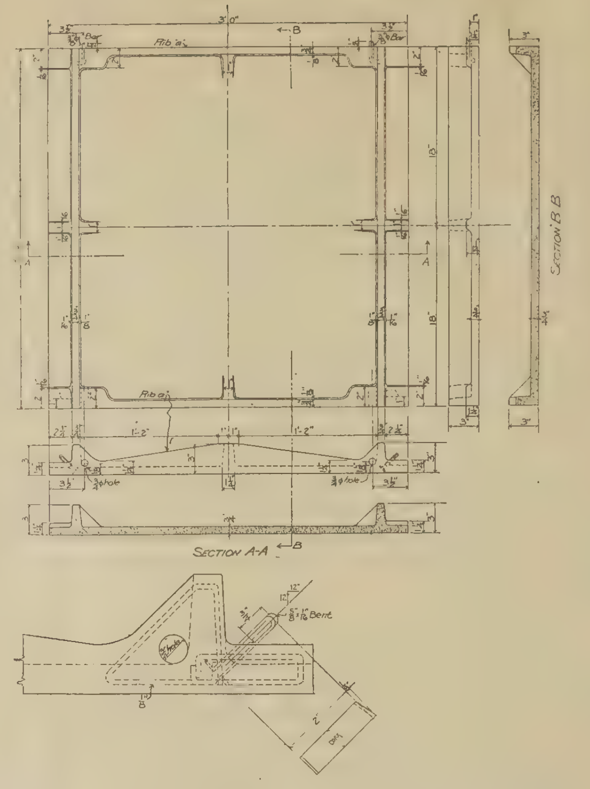


Fig. 1—Detail of Thomas Reinforced Concrete Unit

Thomas Precast Unit System

A system of concrete house construction, with precast, reinforced concrete sections, is proposed and patented by A. O. Thomas, Detroit, Mich. The parts are assembled by a patented locking device that secures them until the pouring of studs and joists is done, this operation tying the whole work together. Details are shown in the accompanying illustrations.

The system consists of two precast tiles, the ribs of which, when brought together, help to form a hollow for columns or studs, which are poured when all the tiles of walls and partitions and floor are put in place. It is a hollow wall system employing concrete in thin sections, reinforced, and joists and studs also receive

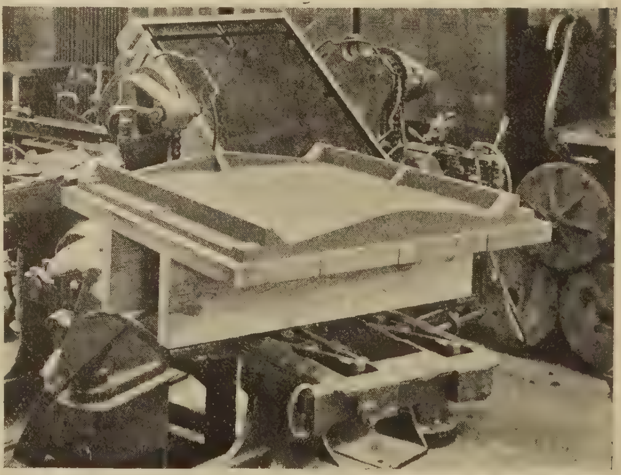
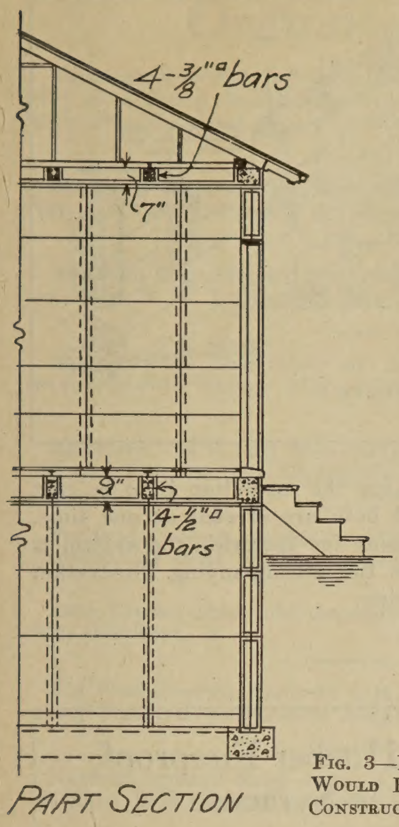


Fig. 2—One of the Thomas Units on Pallet



proper steel before pouring is done. Window and door frames are set in while the walls are going up. The precast sections provide the forms for the studs and joists, which are cast in place. Adjustable shores are employed to support the ceiling tiles until joists are poured and hardened.

It is proposed to finish walls with cement gun stucco. Piping and wiring are to be introduced in walls and floors before pouring is done.

Fig. 3—How Thomas Units Would Be Used in Construction

America Plans Greatest Building Period

American building activity during 1923 will surpass all previous records with an estimated total expenditure of $5,000,000,000, according to reports from architects, contractors and manufacturers of building materials.

It means that the 1922 volume will be exceeded by more than one billion dollars.

Tables prepared by *The Architectural Forum* from compilation of replies from 1,767 architects show that builders have carried their operations through the winter, maintaining an almost steady line from the heavy demand of the fall and winter months of 1922.

Dividing the total estimate in general groups, it is seen that plans for schools, colleges and similar public structures lead the list with $870,034,000. Apartments are next with $662,885,000, and industrial buildings are third with $548,037,000.

An interesting comparison is shown in the total for dwellings, which is $414,132,000, almost as great as the total for offices and also for hotels.

Similar activity of vast proportions is planned by railroads. Actual budget figures for 31 roads, controlling 40% of all trackage in America, call for the expenditure of $387,000,000. Estimates by the *Railway Age* place the total cost of all rail improvement and construction at approximately $900,000,000 during 1923.

Economic experts, studying the construction field, declare the basis for this unprecedented activity lies in the actual lengthening of the so-called "building season."

Building operations in 1922 reached unexpected heights during the summer and carried on through the fall and winter with little abatement. In many localities contractors completed work which in other years would have been carried over, and, in mid-winter, accepted new contracts for prompt delivery.

The result has been far heavier orders for steel, cement, trim and other building materials from the very start of the year 1923 than at any time in the history of the country.

Contractors, realizing the advantages of maintaining their forces of workmen intact from season to season, have carried work right along except in the extremely cold sections, and have ordered additional material for immediate delivery, which they will store until ready for use on new contracts.

The early peak load of demand on freight traffic is expected to feel relief from this steady movement and manufacturers also have been able to pass along the benefits of the longer season.

Many plants which in the past were forced to suspend operations in the winter because of over-loaded warehouses, have been able to run at fair rate and are shipping steadily.

Advertisements for contractors in current periodicals specify that contracts will be taken for 60 and 90 day delivery of homes, a hitherto unheard of thing thus early in the year. This means that materials and labor are promptly available, and that wherever possible the work will be pushed to completion, forestalling the possibility of a builder being buried beneath a mass of unfilled contracts when the demands of the so-called building season are in full swing.

The greatest difficulty faced by the building industry in America has been the problem of the short season. Twelve months of proposed activity were forced into seven months or less.

Transportation became an acute problem, affecting all basic industries. Building materials, coal, foodstuffs and other essentials were hopelessly tied up semi-annually.

The salvation rested in a spreading out of the traffic demands of the materials industry and lines affiliated with the construction field over a longer season.

During 1922 the first effective demonstration of these claims was given to the public and with a record start, 1923 is expected to clinch the argument.

Concrete Pipe Progress

The concrete pipe industry has made rapid strides during 1922, according to the report made by M. W. Loving, secretary, at the annual convention of the American Concrete Pipe Association in Chicago, January 18 and 19. This progress is particularly evident in the sewer and culvert pipe business. The manufacture and sale of drain tile and irrigation pipe has shown a marked increase over 1921. A number of water supply lines have been awarded to concrete pipe. The largest on record is at Tulsa, Oklahoma, requiring fifty-two miles of 54- and 60-in. concrete pipe.

There is evidence of general improvement in the quality of pipe manufactured in practically all sections of the country. Concerns have realized more than ever that in order to establish the business on a firm foundation the highest grade pipe must be produced. Steps have been taken by many concerns to have specifications made more rigid and in certain states laws are being formulated to require the sale of only high grade pipe.

American Road Builders' Association

The convention of the American Road Builders' Association, whose program was published in detail in CONCRETE for January, developed several papers of particular interest to concrete road builders and will have special consideration in the March issue of this magazine.

Concrete Silos

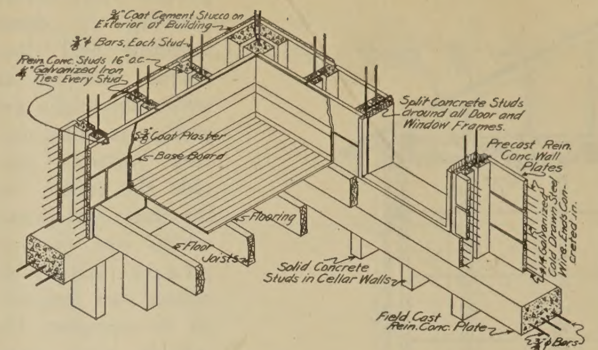
While the silo is just as important to the farmer as ever, and in many respects of more economic importance than before, it appears that there is less interest in the subject of silos than there was a year or two ago. Manufacturers of various silo systems report that in general silo sales are being made with increasing difficulty, and that this difficulty is involved not only with the present financial depression in agriculture, but with the tendency of the farmer to disregard the benefits to be derived from the building of silos and the use of ensilage. A few years ago, when the importance of ensilage feeding and silos was being agitated a good deal through the experiment stations, the farmers naturally had a quickened interest in the subject and silo building was active. The scientific side of the subject having been more nearly exhausted, there is less talk about it in the usual channels through which the information comes to the farmer, and fewer silos are being built.

In an effort to offset this, a movement was encouraged at the convention of the National Concrete Stave Silo Association in Chicago in December to have a national silo conference, in which all those interested in the construction of silos of any kind whatever will participate. This movement started at the annual meeting of the National Association of Farm Implement Manufactures. Effort is now being made in the concrete field by C. C. Woody, chairman of the conference committee of the National Concrete Stave Silo Association, to obtain the necessary funds from the silo builders to finance the conference. It is estimated that $2,000 will be required. Of this amount, the silo division of the M. A. F. E. M. has undertaken to raise half, or $1,000, on condition that the National Concrete Stave Silo Association raise the remainder.

Insulrock System of Reinforced Concrete Construction

Wilson & Gramm, consulting engineers, Buffalo, N. Y., have recently developed and patented a device for molding hollow reinforced concrete walls with one or more air spaces for insulation. The wall consists of precast reinforced concrete slabs or plates for the two faces, to the backs of which are field cast reinforced concrete studs, usually spaced 16 in. apart and made either solid or split. Horizontal reinforced concrete beams at each floor level, cast monolithic with the studs, both above and below, extend around the structure and, with the studs, form a complete structural frame. Stucco or plaster is applied to the roughened precast concrete plates. This system is known by the trade name of Insulrock. Walls of any thickness and studs of any size or spacing may be made, depending upon the loads to be figured. The system is proposed for use not only in house construction, but for factories, warehouses, refrigerating plants, storage plants, and farm buildings.

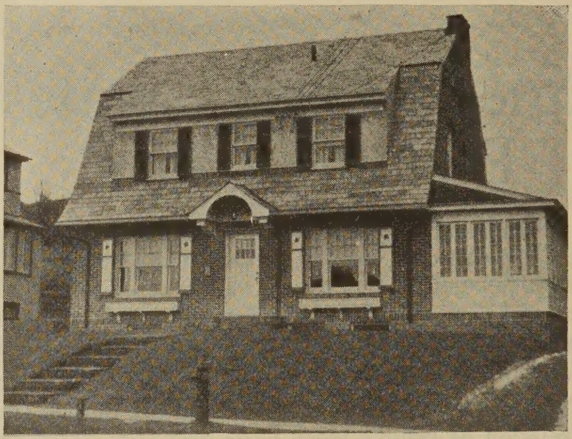
The precast wall slabs are held in place by two metal cross yokes. These yokes are equipped with a spring clip which engages the wall slabs. The yokes are held in place by a separator, which forms the split in the stud and gives the continuous air insulation desired. One set of yokes is required for each stud, and the operation is continuous around the building, one course being erected at a time.

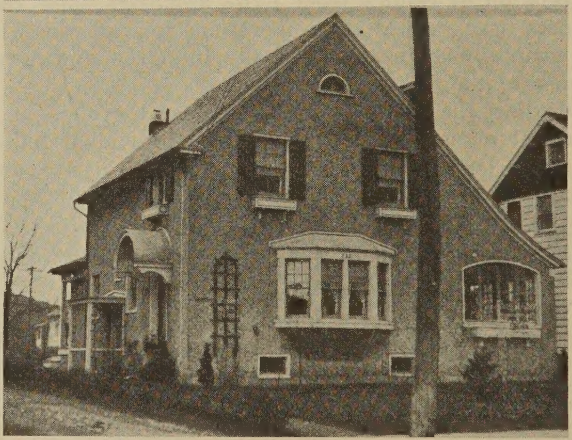

3/4" Coat Cement Stucco on Exterior of Building
3/8 ϕ Bars, Each Stud
Rein. Conc. Studs 16" o.c.
1/4" Galvanized Iron Ties Every Stud
Split Concrete Studs around all Door and Window Frames.
3/8" Coat Plaster
Base Board
Precast Rein. Conc. Wall Plates
Flooring
#14 Galvanized Cold Drawn Steel Wire. Ends Concreted in.
Floor Joists
Solid Concrete Studs in Cellar Walls
Field Cast Rein. Conc. Plate
3/8 ϕ Bars

Details of Insulrock System

For ice and cold storage the insulation is to be cast with the wall slab, and both are erected at one time. For heat and drying rooms for factories, the system is to be used as shown on the accompanying illustration from an isometric drawing.

Two of the Hueber Fireproof Homes in Syracuse





With Hueber Bros., builders, Syracuse, N. Y., the first thought is to build permanent fireproof homes. To do that most economically the structure—walls and floors—is built of concrete. The finish inside and out is a matter of taste—a mere dressing for a good structure.

Organizations

American Concrete Institute; Secretary, Harvey Whipple, 1807 East Grand Boulevard, Detroit. Convention February 25 to 28, incl., 1924; place undecided.

American Concrete Pipe Association, M. W. Loving, Secretary, 111 West Washington St., Chicago.

American Engineering Standards Comm., Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth Street, New York City.

Asso. General Contractors of America, G. W. Buchholz, Secretary, 1038 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers, 123 W. Madison St., Chicago; Wharton Clay, Commissioner.

Portland Cement Association; William M. Kinney, General Manager, 111 West Washington Street, Chicago.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Mid-West Concrete Products Assn., Frank Whipperman, Secretary-Treasurer, 3045 Fowler Bldg., Omaha, Neb.

National Crushed Stone Assn.; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Assn.; Lawrence Veiller, Secretary and Director, 105 East 22nd St., N. Y. C.

The National Lime Association; Mather Bldg., Washington, D. C.

National Sand and Gravel Producers' Association; T. R. Borrows, Acting Secretary, 903 Munsey Bldg., Washington, D. C.

The National Concrete Stave Silo Asociation; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.

New Books

Hendricks' Commercial Register of the United States—31st (1923) Edition, annual, 2,482 pages, 8½ in. by 11½ in.; $15. S. E. Hendricks Co., Inc., 70 Fifth Avenue, New York.

This publication is part of the Hendricks Information Service, which latter also includes Hendricks Commercial Bulletin and the use of the Hendricks Information Bureau.

The new 1923 edition of the Register contains 150 pages over and above the 1922 edition, and 125,000 changes and additions were made. The lists completely cover the electrical, engineering, machinery, building, manufacturing, chemical and other industries, together with all industries allied thereto. The lists are for the use of both buyers and sellers.

Over 18,000 products are separately classified with the name and address following, of every manufacturer or producer, together with the trade name or brand (if any) and also essential facts regarding the products of many of the leading firms. These classifications are made of very easy reference by an admirable system of indexing and cross-indexing.

Seagoing and Other Concrete Ships—By N. K. Fougner, C.E. Size, 6 in. by 9½ in.; 216 pp.; illustrated. Price, $7.00. Oxford University Press, American Branch, New York City.

In this book the author, who has been personally engaged in the construction of some thirty concrete vessels in the past five years, has aimed to present a true record of principal seagoing concrete ships actually built up to date, and to compare them with ships of steel and wood.

Among the points covered are construction details, trials and reports of concrete ships, tugs, floating docks, light ships and lighters.

An appendix contains calculations for the trial ship Askelad, just as they were made in the office. The usual methods for calculating displacement, speed, etc., found in standard works on naval architecture have been omitted.

Elasticity and Strength of Materials, Section 1—By C. A. P. Turner. Size, 6 in. by 9 in.; 86 pages; illustrated. Price, $5.00.

In this book it is intended to demonstrate fundamental principles upon which rational analysis may be founded and to discuss the properties of materials commonly used from the standpoint of the elastician so that the student may apply the analytical methods of the second section, soon to be published, understandingly and in scientific manner.

Trade Publications

Telsmith—The National Road Builder.. Telsmith Bulletin No. 262-A. Smith Engineering Works, Milwaukee, Wis., 16 pages, 7½ in. by 10½ in., paper covers. This is an attractively illustrated pamphlet, describing the company's line of portable crushing and screening plants, all of large capacity and designed to produce first-class, well graded road metal at low unit costs. The equipment described has helped to overcome the prejudice sometimes existing against the development of roadside quarries and pits, by showing that good material can be produced even in temporary operations, provided proper equipment is used. Table of sizes and general dimensions table are included.

Mining, Quarry and Gravel Pit Machinery—Telsmith Bulletin No. 266-B, Smith Engineering Works, Milwaukee, Wis., 28 pages, 7½ in. by 10½ in., paper covers. Numerous illustrations and data are included regarding primary breakers, jaw crushers, reduction crushers, mounted breakers, portable jaw crushers, screens, washing units, etc. A complete new line of sand settling tanks, with improved tilting discharge, designed to produce a thoroughly de-watered product, is cataloged.

Regulating Boiler Feed Water is the title of a booklet which has just been published by the Northern Equipment Co., Erie, Pa. The subject of Copes system of feed water control has been treated in an entirely new way, the object being to cover the subject of boiler feed water regulation completely and yet very briefly. To accomplish this purpose, free use has been made of a graphical method of presentation: charts showing the effect of feed water regulation on water input, steam output, feed water temperature, etc.; also other charts, photographs, etc. There are 20 pages, size 8½ in. by 11 in., and the booklet can be read in less than 15 minutes.

Koehring Crane Excavator, No. 2, is the title of a bulletin issued by the Koehring Co., Milwaukee, describing and illustrating this equipment, designed for excavating and material handling.

Handy Size Mixers—American Cement Machine Co., Inc., a circular describing and illustrating several models of the Packard tilter "lath-a-minute mixer"—especially the Ford trailer model for getting on and off the job quickly.

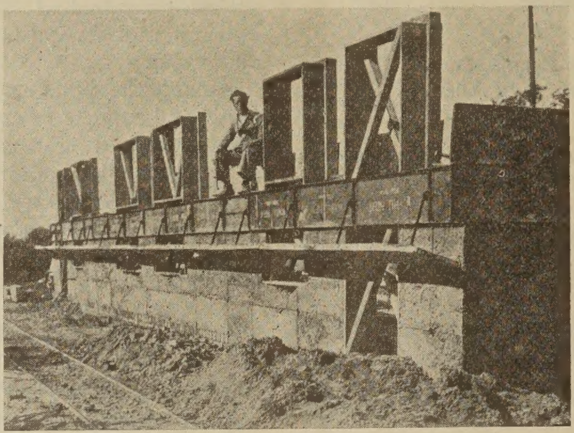
Boss Mixers—Heavy duty type, American Cement Machine Co., Inc., Keokuk, Ia., 28 pages, 8½ x 11—Catalog B23. It describes and illustrates in detail Boss building and paving mixers.

MORRILL PATENT STEEL FORMS

You would not think of going back to a wooden board and hand mixing, yet steel forms are just as important as your concrete mixer. Steel forms require an investment, yes! perhaps you need a thousand dollars worth of them but they will pay big dividends. Every time you "SWING-THEM-UP" you turn your money. In less than 60 days of use steel forms will pay for themselves. After that the saving is all "velvet."

STEEL FORMS STANDARD EQUIPMENT. The Morrill steel forms have become standard equipment. Successfully used on more than one thousand jobs. Adopted and used by the U. S. Government for large operations. Adopted and used by France for rebuilding in the war-destroyed areas, where tests by the French Government showed 40% economy over other kinds of masonry walls.

A CONTINUOUS PROCESS. On the finished footing you can set up one tier of forms. While filling with concrete the second tier is set and later filled, making a finished wall 4 feet high. The oiled steel does not stick to the concrete so that the second day the lower tier of forms can be stripped, swung up, reset and filled. Likewise the third day one tier swung up and filled. Thus at the end of three days work you have a finished wall up 8 feet high. Can you make better time than this with expensive wooden forms?



The Morrill system in France being used to rebuild the war destroyed areas. Note that the lower tier of forms is shown stripped, hanging loose, to be swung-up and set on top ready for the next pour. Note the smooth, straight work done by a crew of laborers.

TOOLS FOR CONCRETE BUILDING. The Morrill patent steel forms are valuable tools to be used over and over again and again, month after month and year after year. The panels, made in various sizes, are pressed from 12 gauge sheet steel and built for hard service. They are adjustable to different sized walls, rigid, straight, self-bracing and self-scaffolding.

CAN YOU AFFORD IT to cut up and waste good lumber where steel forms will turn out better work at one half the cost? Write us for the details of our **Rental-with-option-of-purchase** offer, giving you a chance to "try before you buy." To save writing, you may put your name on the margin of this ad, tear it out and mail it today.

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E. B. KELLEY CO.

Grand Central Terminal, New York, N. Y.

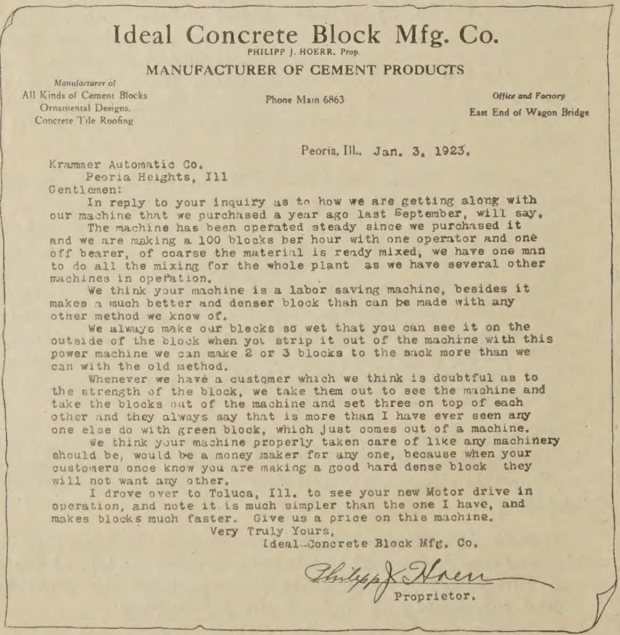
Agent for New England: CHARLES P. PRICE,
P. O. Box 2705 :-: Boston 4, Mass.

Block Makers Read This:

And realize that the Kramer machine tamps 36 blows in the same time that all other tampers require to strike one stroke.

And at the same time the tampers do not have to travel any farther to make 36 strokes than all other tampers do to make one stroke. Where we gain this amount of tamping is in letting the sliding frame that carries the tampers down to do the work, so that the tampers do not have to travel but 1" and yet go to the bottom of the mold and then raise the frame to deliver the block; with this method you can use water enough to get the full benefit of the cement and pack it tight enough so it will not quake; and being a down face stripper, it cannot stick to the mold.

"See what the Ideal Concrete Mfg. Co. says about it"



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MANUFACTURER OF CEMENT PRODUCTS

Manufacturer of
All Kinds of Cement Blocks
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Office and Factory
East End of Wagon Bridge

Peoria, Ill., Jan. 3, 1923.

Krammer Automatic Co.
Peoria Heights, Ill
Gentlemen:

In reply to your inquiry as to how we are getting along with our machine that we purchased a year ago last September, will say.

The machine has been operated steady since we purchased it and we are making a 100 blocks ber hour with one operator and one off bearer, of coarse the material is ready mixed, we have one man to do all the mixing for the whole plant as we have several other machines in operation.

We think your machine is a labor saving machine, besides it makes a much better and denser block than can be made with any other method we know of.

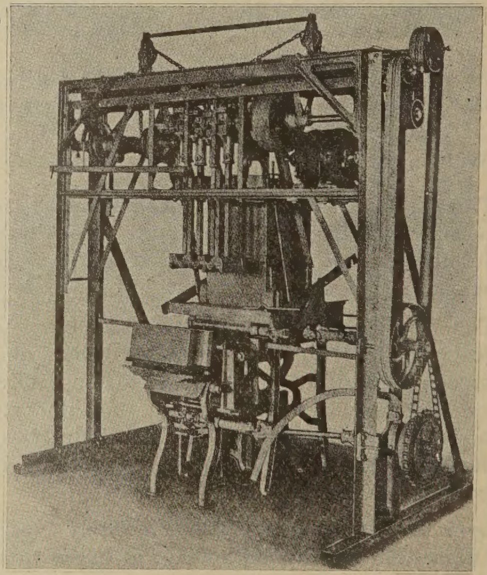
We always make our blecks so wet that you can see it on the outside of the block when you strip it out of the machine with this power machine we can make 2 or 3 blocks to the sack more than we can with the old method.

Whenever we have a customer which we think is doubtful as to the strength of the block, we take them out to see the machine and take the blocks out of the machine and set three on top of each other and they always say that is more than I have ever seen any one else do with green block, which just comes out of a machine.

We think your machine properly taken care of like any machinery should be, would be a money maker for any one, because when your customers once know you are making a good hard dense block they will not want any other.

I drove over to Toluca, Ill. to see your new Motor drive in operation, and note it is much simpler than the one I have, and makes blocks much faster. Give us a price on this machine.

Very Truly Yours,
Ideal Concrete Block Mfg. Co.
Philipp J. Hoerr
Proprietor.



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Furnished With or Without Elevator

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